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MILK-FED VEAL.

A PROFITABLE DAIRY SIDE-LINE.

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THE food consumed by any animal serves a threefold purpose. In the first place, a portion is utilized as fuel for the maintenance of body-heat. A further amount is expended in the production of energy. Finally, any surplus after the two preceding requirements have been met is stored as reserves of fat. The more an animal is exposed to cold and inclement weather, and the farther it has to travel in search of food, the greater will be its heat and energy requirements, and, since the capacity of its stomach is a constant factor, the less will be the surplus available for storage purposes. It follows, therefore, that any economies effected in heat and energy requirements will leave a greater surplus to be built up into reserves of fat. In the colder climate of the Northern Hemisphere farmers have long appreciated the economic importance of warmth, protection, and rest in the successful fattening and finishing of stock for the butcher. Thus the Irish pig-farmer, whose successful pig-raising is a byword, not infrequently has his substantially constructed fattening-pens constructed under the one roof. The pens are well bedded down with fern or other litter and ranged round the walls, while in the central space a slow-burning peat fire is kept continuously alight during the colder winter months.

The excellence of Sussex-fed fowls and French capons is known by repute the world over. The method of finishing is similar in either case, the birds being closely confined in semi-darkness and a warm atmosphere, with abundant food always before them, or they may even be forcibly fed. Similarly, cattle being fattened for the butcher are closely housed in warm barns, knee deep in dry litter. The result is the same in all cases—the animals or birds eat their fill of fattening meals and, encouraged by full stomachs and the warmth and comfort of their surroundings, spend most of their time between feeds in sleep. In other words, their heat and energy requirements are reduced to a minimum and the bulk of the food digested is rapidly piled up in fat reserves.

From the consumers' point of view a further advantage accrues from this system. Since the fattening animals or birds expend practically no muscular energy, their muscle-fibres become extremely soft, and the meat is in consequence much more tender and juicy.

In addition to the increased rapidity of the fattening-process and the improved quality of the meat there is a very substantial saving in time and also in the amount of foodstuffs consumed. Controlled feeding trials have demonstrated that, in securing a given increase in weight, the provision of adequate shelter and warmth may result in a saving of as much as from 15 per cent. to 18 per cent. of the total food-consumption.

Last spring Mr. P. A. Openshaw, a Taranaki dairy-farmer, applied the principles outlined above to the fattening of vealer calves. The experiment proved so far successful that the results are well worthy of consideration as exemplifying an alternative and profitable method of utilizing part of the milk-supply. The calves used in the experiment were ordinary Jersey-cross "bobbies" from the dairy herd. They were closely penned from birth onwards in snug enclosed pens and were fed all the whole milk they would consume, supplemented by a small quantity of linseed-meal. The calves showed phenomenal increases in weight, and were sold to the butcher when from one to two months of age. The flesh met with a very ready demand, realizing 4½d. per pound dressed weight, and, needless to say, proved immeasureably superior to that of the ordinary runner calves. Eight calves were fattened during the spring months and all showed more or less uniformly satisfactory returns. In the case of the first four calves detailed records of the whole-milk consumption of each animal were kept. After making due allowance for the initial value of the calf, the litter used, and the linseed-meal consumed, the price realized for the meat showed a return of 10d. per pound of butterfat on the milk consumed. In the event of butter realizing more than this figure it would prove more profitable to supply the factory, but, conversely, the further the return for butterfat fell below 10d. the greater would be the margin of profit in calf-fattening. There is no doubt that, in view of the low factory returns prevailing during the past season, Mr. Openshaw's calves proved quite a paying side-line.

The data covering four calves are given in the table which appears below. In arriving at the costings it should be explained that the value taken for each calf was that placed upon it by the "bobby"

	Value of			Whole Milk consumed.	Equal to Butter-fat (4·0 per Cent. Test).	Age when slaughtered.	Dressed Weight of Carcass.	Value of Carcass at 4½d. per Pound.	Return on Milk consumed (preceding Column less Sum of Columns 1, 2, and 3).	Return per Pound Butter-fat.
	Calf.	Litter.	Linseed-meal.							
	s. d.	s. d.	s. d.	lb.	lb.	Days.	lb.	s. d.	s. d.	d.
Calf 1	5 0	3 6	4 0	1,020	40·8	50	126	47 3	34 9	10·2
Calf 2	5 0	3 6	4 0	1,332	53·3	62	154	57 9	45 3	10·2
Calf 3	4 6	3 6	4 0	1,125	45·0	54	119	44 7½	32 7½	8·7
Calf 4	4 0	3 6	4 0	550	22·0	28	84	31 6	20 0	10·9
Totals ..	18 6	14 0	16 0	4,027	161·1	194	483	181 1½	132 7½	9·9

buyer at the farm-gate and ranged from 4s. to 5s. according to the size of the calf. A fair quantity of rough hay from the stack tops and bottoms was used as litter. The cost of this has been debited at a flat rate of 3s. 6d. per calf—mainly to cover cost of cartage and handling, since it was practically valueless in itself. The total cost of the linseed-meal consumed came to 16s., which was apportioned equally between the four calves, since records of individual consumption were not kept. The meal was added to the milk from the end of the first week, commencing at the rate of one tablespoonful and gradually increased to ½ lb. per calf per day. The factory test for the herd during the period was generally 4·0 per cent., though it fell to 3·8 per cent. on one or two occasions. However, the higher test has been used as the basis of the costing calculations.

The average figures for the four calves thus show a return of practically 10d. per pound of butterfat on the quantity of milk consumed. Calf 3 proved a comparatively poor "doer," and so reduced the average slightly.

As already noted, records of the milk-consumption of the remaining four calves were not kept. However, their ages and weights at time of slaughter were as follows: 133, 128, 172, and 82 lb. dressed weights at 50, 50, 70, and 30 days respectively. The first group of calves consumed 4,027 lb. milk in 194 feeding-days, or an average of 20·7 lb. milk per calf per day. Applying this figure to the second group of calves, it may be assumed that their total consumption of milk would be approximately 4,140 lb. milk for the 200 feeding-days, equivalent to 165·6 lb. butterfat at a 4·0-per-cent. test. If each calf in the second group be valued at 5s. and litter and meal as before, we arrive at a flat rate debit of £2 10s. for the four calves. Deducting this from the return from the meat (515 lb. at 4½d. = £9 13s. 1½d.) this group of calves shows a return of £7 3s. 1½d. for the consumption of 4,140 lb. milk, or 10·4d. per pound of butterfat.

The quality of the carcasses when dressed was of the highest order, and it would have been almost an impossibility to find any fault with them. The illustration (Fig. 1) of the carcass of calf 2 (154 lb. in sixty-two days) speaks for itself, and its study will convey more than a lengthy description. The quantity and quality of the kidney-fat is in itself a sure indication of the prime condition of the carcass.

On the data given it might be assumed that the younger calves killed at twenty-eight and thirty days respectively showed the best returns. This assumption must, however, be qualified by the fact that calf No. 4 proved the best "doer" of the eight right from the start. The last calf, on the other hand, was a large-boned Friesian animal obtained from a neighbouring herd, and did not do so well as some of the others. Its killing weight must therefore be discounted to some extent by the fact that its initial weight was considerably greater than that of the remaining calves in which the Jersey strain predominated. Furthermore, the butcher reported that while these two calves were of excellent quality, the carcasses did not contain the same proportionate amount of fat as the older calves.

The outstanding quality of the product was fully appreciated by the trade, and the higher price was obtained without any difficulty, and, had they been available, many more calves could have been disposed of at the same figure.

Since by no means the least important factor in the success of this "hothouse" rearing of calves lies in the provision of suitable quarters designed to provide the maximum warmth and comfort, due attention

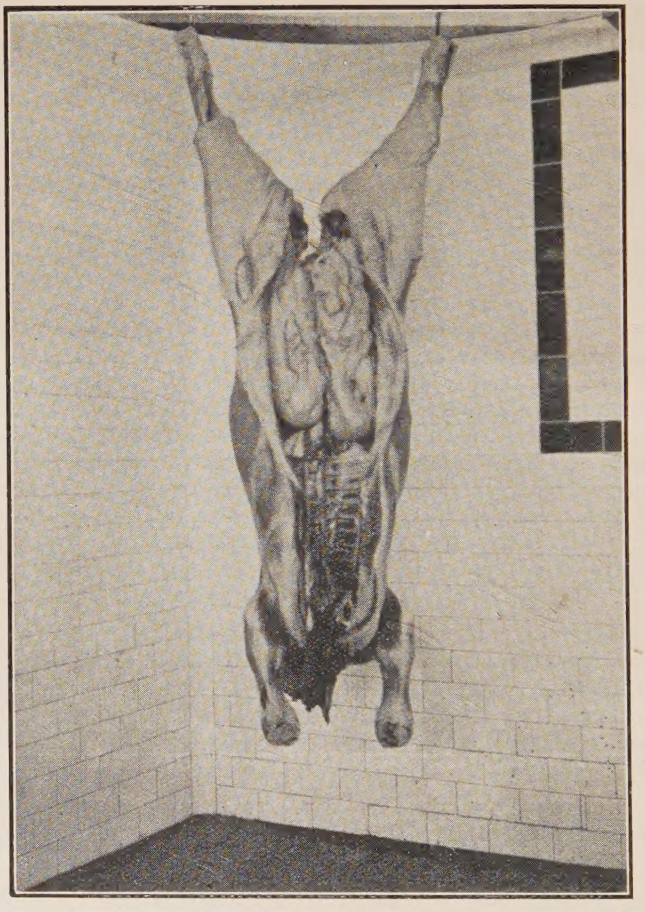

FIG. 1. CALF NO. 2: 154 LB. DRESSED WEIGHT IN SIXTY-TWO DAYS.

must be given to this point: Any attempt to emulate these results is foredoomed to failure if the calves are merely shut up in a cold, damp shed. The essentials to bear in mind are: (1) The exclusion of all cold draughts; (2) the exclusion of as much light as possible; (3) the provision of a warm, dry bed. Any enclosed shed will serve the purpose, but if the weather-boarding is not draught-proof or if the walls are of iron construction, the studs should be lined with wire

netting to a height of about 5 ft. and the spaces between the outside wall and the netting packed with rough hay, fern, or other similar material. The pens should be then constructed against this "padded" wall. Each pen should measure approximately 4 ft. 6 in. by 3 ft., and be closely boarded. The dividing partitions need to be carried up to a height of 5 ft. and the whole roofed with more wire netting on which a layer of rough hay, &c., is placed. The front wall should be carried up to a height of approximately 3 ft. 6 in. and the gap of 18 in. intervening between it and the roof utilized for feeding and bedding the calf. It may be closed by a curtain of old sacking, if necessary, in order to exclude further light. A generous bed of litter should be supplied in the first instance, and the pens not cleaned out, but further litter added on top from day to day as required.

The calves require to be fed twice daily and allowed to drink as much as they wish. One calf was put on thrice-daily feeding for a period, but it was found that it did not consume any more milk and did not thrive any better than on the twice-daily feeding. Another experiment using skim milk and slightly increasing the supplementary feeding of meal also proved unsatisfactory.

At the present time, in view of the low prices prevailing for dairy-produce and the threatened overproduction, there should be much to recommend this method of fattening vealer calves. It will divert a certain quantity of milk from the factories into a channel which, with a negligible initial outlay, should prove a profitable side-line. Without going into the possibility of an export trade and considering only the local market, one hundred thousand calves fed under this system would utilize milk equivalent to approximately 2,200 tons of butterfat, and at the same time show a return of 1½d. to 2d. per pound more than the factory pay-out at current rates.

In conclusion, it may be as well to reiterate that the whole secret of the success of this system lies in providing proper fattening-pens in which the warmth, comfort, and semi-darkness encourage the calf to eat, sleep, and grow fat in the minimum time and on the smallest quantity of food.

Acknowledgments are due to Mr. Openshaw for the careful manner in which he kept the records and placed them at the writer's disposal and also for the courteous manner in which he always received the various officers of the Department who frequently visited and inspected the calves during the course of the experiment.

The Fields Superintendent, Palmerston North, reports that a poor, light property, of under 400 acres, near Ongaonga, Hawke's Bay, previously carried 450 ewes, and, with the assistance of 20 acres of rape and 30 acres of swedes, the owner managed to get most of the surplus stock off fat by the middle of June. He has been introducing subterranean clover during the last six years in mixtures, and now runs two ewes to the acre and fattens all surplus stock before the subterranean clover dries up in summer. One paddock of 30 acres sown with a very heavy proportion of subterranean clover carried 150 ewes and lambs last season, and it is stated they could not "hold" the growth.

CHEWINGS FESCUE.

THE PROBLEMS OF GERMINATION AND PURITY AND THEIR INFLUENCE ON GREENKEEPING AND COMMERCE IN THE UNITED KINGDOM.

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Chewings fescue plays an important part in the formation of fine sports turf, and the bulk of the seed is utilized for that purpose. At the outset it may be stated that until comparatively recent years the chief importing countries of this seed were the United States and Canada. That the United Kingdom can now be regarded as an important customer is revealed by the import figures for the past five years. These show that over 600 tons of Chewings fescue were imported by the United Kingdom during that period. In 1932 the tonnage imported was the highest in the history of this country, but, unfortunately, the germination, almost without exception, fell very rapidly. This drop in germination after arrival in the United Kingdom is well known, and has been attributed to various causes, whilst furthermore the trouble is more widespread in some years than in others. The following table is of considerable interest and importance, as it illustrates the germinating capacity which exists at the time of shipment as well as on arrival of the same lots in the United Kingdom. These figures have been obtained as a result of communication with the largest importers in this country.

Table 1.

Percentage of Germination at Time of Shipment.	Percentage of Germination after Arrival (Official Seed-testing Station, Cambridge).
97	66
94	57
94	86
90	75 August. 45 March.
96	50
90	90 September. 72 March.
90	64
95*	75

It will be observed that practically all these cases show a marked drop in germination on arrival here. Not only has this loss in germination during shipment to be contended with, but frequently there is also a rapid deterioration during storage after arrival. In the last quoted example* the germination in six months fell to 22 per cent., and, finally, after a further three months, registered only 7 per cent. Many other similar cases could be recorded, all of which have incurred big financial losses. On the other hand, the 1933 crop has not suffered in this way and up to the present time the germination has been well maintained. Certain seed houses report no germinations below 90 per cent.

The outcome of all this uncertainty is an increasing reluctance on the part of the importer to handle the seed. One firm writes as follows :—

"We do not intend to stock New Zealand Chewings fescue, because it loses its germination power so quickly. This fact is not understood by the golf clubs here, who expect to be able to purchase this variety at any time of the year with a very high germinating-capacity."

Not only does the problem of germination of Chewings fescue require investigation, but there is need for much closer attention in the matter of purity. Rarely is the seed of this species free from seeds of perennial rye-grass and Yorkshire fog, both these being highly objectionable lawn-weeds. In the production of high-class lawns and turf to sow seeds which are contaminated with even small amounts of these impurities is to court disaster. The reasons for this are not very far to seek. First and foremost, where lawn seeds are concerned, the method whereby the impurities in a seed-sample are expressed does not and cannot give one a true conception of the degree of contamination. To report that 1 per cent. by weight of a seed sample consists of a given impurity is one thing ; to know what this means in number of seeds of that impurity, is altogether another. For instance, in the case of the impurities mentioned : if a sample of Chewings fescue containing 0·1 per cent. of perennial rye-grass as an impurity is sown at 3 oz. per square yard, in effect we have introduced in our sowing no less than forty-two seeds of perennial rye-grass to each square yard. Assuming the impurity to be Yorkshire fog and the rate of seeding and the percentage of impurity as before, the final result will be the introduction of approximately 170 seeds of this undesirable species to each square yard. The potential danger from weed impurities, even in small amounts, is thus considerable.

The second reason is self-obvious — the disfigurement caused by the presence of even small numbers of coarse-leaved and tall-growing plants in an otherwise fine, close-growing turf. No effort, therefore, should be spared in securing samples free from the species mentioned, since the high rate of seeding involved in the production of fescue turf renders an insignificant amount of impurity a matter of disturbing importance. In further connection with this it is interesting to report on a series of six plots sown down at the Research Station in 1931. Red fescues alone from varying sources were utilized, the plots being adjacent.

Table 2.

Plot No.	Purity of Seed.	Percentage of Ground covered by Yorkshire Fog, January, 1934.
	Per Cent.	
1	82·69 (no Yorkshire fog)	Trace.
2	88·4 (no Yorkshire fog)	Nil.
3	97·7 (no Yorkshire fog)	1·0
4	92·6 (0·1 per cent. Yorkshire fog)	20·0
5	98·5 (no Yorkshire fog)	Nil.
6	98·6 (no Yorkshire fog)	2·5

It will be seen from the above that in five out of the six plots there is little or no Yorkshire fog. However, in plot No. 4 where the impurity

of Yorkshire fog was only 0·1 per cent.—an apparently negligible amount —20 per cent. of the ground is now covered with plants of Yorkshire fog, which factor ruins it for the purpose of golf-green turf. That the Yorkshire fog impurity in the seed is chiefly responsible for the condition of this plot is evident, and such a view is supported by numerous other trials in progress, all of which reveal the devastating effects of small amounts of impurities, particularly Yorkshire fog and perennial rye-grass, when the seed rate is frequently in the necessary region of 9 cwt. per acre.

It is this feeling of insecurity in the employment of Chewings fescue that is so disturbing. Firms are showing reluctance to concern themselves with this species, and those whose duty it is to give advice on seeds and seeds mixtures for sports turf purposes run the risk of involving their clients in financial loss and unsatisfactory results. The appearance and value of a turf produced with seed of low germination and contaminated with weed species must obviously be far from good, and, regarding the impurities, it should be remembered that these, when once established in the turf are difficult and costly to remove.

It needs to be realized more fully by the growers and exporters in the Dominion that Chewings fescue is utilized chiefly for the production of lawns and sports turf and seldom for agricultural purposes. In this sphere this species has been extensively used as an ingredient in seeds mixtures, primarily with the object of acting as " nurse " to the slowly developing bent grasses which are the foundation of all first-class greens and lawns. Moreover, Chewings fescue mingles exceedingly well with bent grass such as New Zealand bent, and undoubtedly adds considerably to the general character of the turf. It is when we consider Chewings fescue in this role of " nurse " crop that we are confronted with perhaps the weakest link in the chain of its usefulness ; a weakness which is slowly undermining its popularity with both importers and users in the United Kingdom. The ability to be quickly " off the mark " when sown is essential in a species to be sown in conjunction with New Zealand bent. The *Agrostis* species—foundation of the mixture and the turf to be formed—makes but slow progress in the initial stages and, in addition, is frequently set back by seedling disease. It is obvious, therefore, that unless Chewings fescue can show a final germination of at least 90 per cent. with the greatest proportion of this in seven to ten days, it must fail to " fill the bill."

Vastly different will be the result of Chewings fescue imported in 1933. There can be no lack of vigorous seedlings making their appearance quickly through the ground from seed which arrives in this country growing 95 to 99 per cent., and when tested at the time of writing, (February) can show in seven days a germination of 86 per cent. with a final growth of 94 per cent.

Experiments to elucidate these difficulties have not been as extensive as could be desired, or indeed as would appear to be warranted by the nature and the importance of the matter. In 1925 the Seed Analyst at Wellington reported on a series of experiments designed to investigate which factors were responsible for the shipment troubles, and, as a result, recommendations to growers were put forward. These lay chief

emphasis on the need for delayed cutting, together with stacking in order that mature seed be obtained. It may also be reported that shipments have been made in cool storage to test the validity of the view that tropical temperatures and high humidity conditions operating on ship-board are responsible for the deterioration of the seed in transit. Despite these recommendations and investigations 1932 proved the most disastrous year for importers, merchants, and greenkeepers in the United Kingdom.

Whilst it is not intended to make definite suggestions here regarding those problems which need further investigation, certain facts in the production of seed generally, and Chewings fescue in particular, are not perhaps without interest and significance. The tendency for seed harvested on the under-ripe side to "go off," particularly if subjected to unfavourable storage conditions, is well known. The experiments of Jacques and Corkill with crested dogstail (*Journal of the Ministry of Agriculture*, May, 1932) clearly show that high vitality and high germination are coincident with maturity of the seed, and this condition is linked with seed colour. The authors cited indicated that the immaturity of much New Zealand crested dogstail seed with consequent lack of vitality may be the cause of its inability to withstand shipment overseas. It may be that this same factor operates in the case of Chewings fescue and undoubtedly investigations into this matter should be made. That any investigations must of necessity be initiated in New Zealand is obvious. The fact that different parcels of seed on the same boat, all of similar high growth when shipped, show different germinations on arrival here, and that seed carried in ordinary cargo has arrived with equally good growth as those shipped in cool storage seem to indicate that the factors responsible operate prior to shipment.

In disposing of the difficulties presented, we extend to investigators in the Dominion a hearty invitation to co-operate with this country, particularly in undertaking the necessary tests after shipment. The Chief Officer of the Official Seed Testing Station has expressed his willingness to co-operate in every way possible. Finally, the solving of the problems concerned requires concerted and immediate action. The outcome of this, it is hoped, will be the widespread adoption by growers of methods which will ensure elimination of the impurities which so reduce the value of their seed crops, and at the same time by solving the problem of depleted vitality after shipment, renew that confidence amongst traders and greenkeepers in the United Kingdom which this species of grass undoubtedly deserves.

The Field Instructor, Christchurch, reports that at Riccarton an area of lucerne was sown three years ago on land which was limed at the rate of 1 ton carbonate per acre. A further ton of lime per acre was applied later, but the lucerne was pale in colour and did not flourish until inoculated soil at 4 cwt. per acre was applied in 1932 season. The stand is now an excellent one.

The Instructor in Agriculture, Oamaru, reports that at Papakaio ryecorn was sown on light soil about the end of April with a seeding of 2½ bushels per acre, the total area sown being 40 acres. From it eight hundred ewes had grazing for two hours per day after turnips during most of the month of September. The crop must be grazed fairly short all the time, as if allowed to come away too far it becomes coarse. The farmer was well pleased with it owing to the fact that it can be sown later than Cape barley and also because it withstands very hard frosts.

DETERIORATION PROBLEMS IN NEW ZEALAND CHEWINGS FESCUE.

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Deterioration in the germination capacity of Chewings fescue seed during shipment from New Zealand to northern countries has for many years been a constantly recurring trouble, yet, in spite of this fact, the annual export totals have remained reasonably steady. The total annual export for the years 1926-33 is shown in Table 1.

Table 1.—Chewings Fescue: Export, 1926–33.

——	United Kingdom.	United States of America.	Canada.	Total.
	Tons.	Tons.	Tons.	Tons.
1926	192	425	50	696
1927	168	521	50	870
1928	107	619	75	851
1929	119	544	109	842
1930	77	435	50	640
1931	143	475	96	705
1932	187	401	53	672
1933	294	592	57	966

American buyers appear to have accepted Chewings fescue as a characteristically delicate and short-lived seed, and, although periodically complaints have followed unsatisfactory deliveries, particularly in unfavourable production seasons, the demand has been well sustained. Naturally, with the continuance of a retail demand, the importers meet it, and as far as the American retail market is concerned no serious complaint appears to have been made. Presumably Chewings fescue is regarded as low-germinating species, and therefore a high-germination capacity is not expected.

Until the advent in Great Britain of green-keeping research, the same remarks might well apply to the British trade, but investigation into the relative values of various fine-leaved turf grasses has disclosed the fact that although Chewings fescue is a desirable turf constituent much of the seed retailed is of a very inferior quality and, by virtue of this fact, of little value in sports-turf establishment.

It has been made quite plain that if Chewings fescue can be landed in Great Britain with a sufficiently high vitality to permit of its retaining a reasonable high-germination capacity up to the time of retail sales—say, six months—then the prospects of an extension of the present trade are most encouraging. On the other hand, it is equally clear that if the trade continues on the present lines those in a position to do so will not be prepared to recommend unconditionally the use of the seed, and this will be obviously to the detriment of the industry in New Zealand. The fact that the various forms of European fescues are at present

under investigation in England, although not necessarily with the one idea of replacing New Zealand seed, will tend to create an independent attitude on the part of British consumers.

The attitude of the consumer section of the American trade is not so clearly defined; one assumes that the retail trade is satisfied with present conditions, but it is very probable that if the quality of the seed moving on to the retail markets was of a known higher standard the American demand would be improved. Dissatisfaction with deliveries of New Zealand seed was no doubt responsible for several attempts to grow Chewings fescue in several States, and, although these attempts were not attended by any great success, they are not without significance.

It will be agreed, therefore, that a somewhat critical stage has been reached in the history of an industry which, although not nationally important, is a profitable phase of farming in the southern districts, and, furthermore, in these days of economic stress any industry, even although relatively of small dimensions, which exists comparatively without competition, should be developed to its utmost capacity.

Previous Investigational Work.

Prior to 1925 many theories as to the cause of deterioration of grass-seed during shipment were put forward both in New Zealand and abroad. Most of these were investigated and, together with the results of some experimental work carried out with Chewings fescue, reviewed by the writer in this *Journal*, 1925.* From the the data presented it was concluded that, contrary to general opinion, deterioration was due to unfavourable shipment conditions to which Chewings fescue and crested dogstail were peculiarly susceptible, that the unfavourable conditions were associated with high degrees of temperature and humidity. Furthermore, it was recognized that the degree of deterioration was controlled to some degree by seed-vitality, which in turn is influenced to a marked degree by a number of factors operating during production, the chief of which were seed maturity at harvesting, maintenance of soil-fertility to a standard of fescue requirement, and the renewal of worn-out pastures.

So far as the production of fescue is concerned, in the light of further experience, in the opinion of the writer, these views still hold good. Well-matured seed harvested from vigorous healthy stands invariably ships and stores well under average conditions, and in normal production years, by its superior quality, is distinguishable when shipped with other lines under identical conditions.

Causes of Deterioration.

The fact that the germination capacity on arrival of several lines shipped on the same steamer is not always consistently high or consistently low has led to the suggestion that the cause or causes must be associated entirely with production, for the reason that were transit conditions responsible all lines would deteriorate

* *New Zealand Journal of Agriculture*, Vol. XXXI, 356–370.

to an equal degree. An acceptable theory for this inconsistency has already been given, and of far greater significance is the fact that invariably there are wide discrepancies between the germination capacities of exported seed and of portions of the same lines retained under normal storage in New Zealand. Such discrepancies naturally can be accounted for only by deterioration during shipment and, as suggested previously, are undoubtedly due to excess of heat and/or humidity obtaining in the ship's hold. The effect of these conditions on most short-lived seeds is known to every seedsman, who, wherever possible, provides dry, well-ventilated space for bulk storage. The conditions under which seed is shipped from one hemisphere to the other are, in most cases, the antithesis of shore conditions—hold temperatures particularly in the tropics are known to be much above normal and the relative humidity of the air surrounding the seed following temperature increases must be unduly high. Unfortunately, no reliable data concerning the temperature and relative humidity of ships' holds are available, but from various observations it is known that both conditions are almost invariably excessive.

The high relative humidity of the storage atmosphere is due partly to the release of water vapour from the seed itself, and is partly, in some instances, provided by associated cargo. At all events, sufficient moisture is carried by the seed to exercise harmful effect when temperatures are increased. All seeds naturally contain a certain amount of moisture, the amount varying with the type of seed. Grass-seeds have, in most species, attached glumes, and a proportion of the moisture content is held by the glumes. Therefore the percentage moisture content of a sample of seed such as Chewings fescue is actually disproportionally high and is more readily released than is the moisture held by the grain. It is probably the glume moisture which is responsible for the rapid changes in the relative humidity of the storage air under the influence of temperature changes.

In order that some information could be obtained relative to the effects of high temperature on viability, laboratory experiments were instituted which showed that excesses of both conditions effected rapid deterioration, that an excess of one condition with the other at normal caused a slower deterioration, and that, provided one condition was reduced below the normal level, the other could be raised to excess without harmful result. The results of this experiment are presented in Table 2.

For the purposes of the experiment seed from one line was divided into three portions; for the first the moisture content was reduced by drying to 5 per cent., for the second the moisture content was allowed to remain at normal (13 per cent.), and for the third the moisture content was increased to 20 per cent. Seed from each of the three portions was then placed in sealed glass vessels and a number of each stored at constant temperatures of 30° C., 40° C., and 50° C., and one series at room-temperatures (16 to 20 C.). At regular intervals tubes from each storage temperature were removed and the contained seed tested.

Table 2.—Chewings Fescue: Results of Storage of Seed of Low and High Moisture Content under Different Temperatures. (Initial Germination Capacity of Seed, 98 per Cent.)

Period of Storage, in Days ..	1.	2.	3.	4.	5.	6.	7.	10.	14.	21.	35.	42.
Storage Temperature.	Moisture Content.	Germination Capacity (Percentage).										
°C.	Per Cent.											
50	5	97	..	98	..	97	..	97	..	98	97	98	97
50	13	96	90	86	54	15	11	9	2	..	..	..	..
50	20	94	70	57	19	..	..	..	..	..	..	..	..
40	5	98	..	96	..	96	..	97	..	98	98	96	98
40	13	96	97	91	93	92	84	73	67	38	21	15	10
40	20	94	93	87	85	86	73	66	43	12	2	1	..
30	5	98	..	96	..	97	..	98	99	98	98	97	96
30	13	97	96	96	94	95	88	85	84	82	85	79	75
30	20	95	94	90	88	81	82	79	76	57	39	10	5

Period of Storage, in Months	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Room Temperature.	Moisture Content.	Germination Capacity (Percentage).										
	Per Cent.											
°C. 16–20	5	98	99	96	97	96	98	97	95	96	95	87	96
	13	99	96	97	99	91	93	93	85	81	75	68	60
	20	97	97	93	89	78	57	10	..	..	..	..	..

It is not claimed that the conditions to which this seed was exposed were an exact replicate of conditions existing in the hold of a steamer, but it is considered that a temperature of approximately 40° C. (86° Fah.) for some days is an estimate of the conditions prevailing in a ship's hold during the passage through the tropics. Examination of Table 2 shows that at this temperature seed with a normal moisture content of 13 per cent. shows signs of deterioration on the third day and by the seventh day has lost over 20 per cent. In the same period the germination capacity of seed with a moisture content of 20 per cent. had fallen to 66 per cent. Referring now to the series at 50° C. (122° Fah.), it is seen that in five days seed with normal moisture content has fallen to 15 per cent. germination, that with a 20 per cent. moisture content has deteriorated completely, while the samples with a reduced moisture content of 5 per cent. are unaffected at the expiration of the experiment in forty-two days. The series at room-temperature was conveniently continued for a period of months, no deterioration being observed until the third month, when the seed with a 20 per cent. moisture content showed a slight loss. Further comment appears to be unnecessary, as it is the writer's contention that a clear case has been made against associated conditions of temperature and humidity. It may be doubted whether hold-temperatures ever do exceed 30° C., but actual experiences would tend to confirm the belief that they probably exceed 40° C. For example, shipments have been delivered at east

coast American ports showing a germination capacity of less than 10 per cent. Subsequent investigation showed that several periods of excessive temperature had occurred.

Laboratory experiments have shown that seed that has deteriorated rapidly under excessive temperature to, say, 70 per cent. does not continue to do so with the return of normal conditions, the fall continuing at a rate slightly higher than normal. In fact, even if deterioration occurs to a slight degree only, subsequent storage losses appear to be accelerated, which could be accounted for by the weakening effect of high temperatures on viable seed.

Although normal losses in stored seed must be expected, complaints of heavy storage losses in England would appear to be justified. At the same time, however, it is very doubtful whether it could be claimed that Chewings fescue is invariably stored under conditions requisite for this type of seed. Humidity is likely to be high in the northern winter, and interior temperatures higher than 20° C. (68° Fah.) would tend to accelerate deterioration.

One point calling for brief mention is the variation in seed quality (as evidenced by vitality) from season to season. Every two or three years an abnormally good or abnormally poor production season occurs and occasionally one good season succeeds a poor one. The 1932 and 1933 harvesting seasons were typical in this respect; seed for 1932 shipped very unsatisfactorily and deteriorated rapidly after delivery, whereas 1933 seed shipped and stored remarkably well. The explanation seems to be that in some years climatic conditions are such that seed can remain longer in head and become thoroughly mature before harvesting, whereas in the less favourable years the seed "ripens" more quickly and has to be harvested to prevent losses by seed fall. Overseas buyers should therefore understand that these often very marked quality variations are entirely seasonal and beyond control. It should also be mentioned that seed produced in an "off" season deteriorates at a rate distinctly higher than average while in storage in New Zealand.

Remedial Measures.

The general overseas opinion appears to be that the prevention of transit losses lies in improvement in production methods. To a limited extent this is true, as repeated reference in this article to seed-vitality will testify. The production of seed of the highest possible vitality is most essential, and to this end nothing but thoroughly mature seed saved from healthy, vigorous stands should be saved and offered for the export trade. Seasonal conditions will at times tend to nullify growers' efforts in this respect, but seed of heavy weight and high quality must in all seasons be the growers' ideal.

It has been stated previously, however, that the production of high-quality seed may be regarded as only a partial remedy, and an insecure one at best. It is therefore very clear that as transit conditions are responsible for deterioration that either these conditions must be altered or that seed be prepared to withstand conditions unfavourable to it.

It has been shown that associated conditions of high temperature and high humidity are directly responsible for transit losses, and that provided one of these conditions is reduced below normal the other may rise to abnormal levels without causing harm. Two alternatives then present themselves, either cool storage or the reduction of humidity by artificial drying of the seed itself, both of which possess merits and demerits.

Cool storage has already been put into operation in 1933, when, following the circulation among exporters of data included in Table 2, which was posted overseas to importers, an immediate demand was created for cool-stored shipments. This was filled so far as suitable and available insulated chambers would permit, but, unfortunately, purely from the experimental point of view, the high quality 1933 seed in many instances carried almost equally as well in hold storage as in cool storage. Nevertheless, the differences in germination capacities of seed shipped under either one of the two methods were significantly in favour of cool storage. There are, however, attendant disadvantages, the chief of which perhaps is the difficulty in securing suitable space on conveniently sailing steamers. The trade is not sufficiently large to warrant the provision of special accommodation for seed, and shipments have to be adjusted to suit what is offering. Secondly, normal deterioration appears to continue during the period of cool storage—admittedly at a slightly slower rate—and is also not in any way prevented during storage after delivery—an important point.

Artificial drying prior to shipment has not yet been attempted commercially with Chewings fescue, the opinions expressed in this article regarding its efficacy being based entirely on information gained from experimental drying on small-scale shipments made in co-operation with two overseas seed-testing stations—the Official Seed Testing Station for England and Wales at Cambridge, England, and the Division of Seed Investigations, Department of Agriculture, Washington, D.C., United States of America.

Investigational Work.

It will be advisable, before any discussion as advantages or otherwise of artificial drying is attempted, that certain experiments be outlined and the results obtained therefrom presented and commented upon. Some of the experiments have a bearing also upon cool storage.

Experiment 1: To determine the Effect of Artificial Drying on Commercial Seed shipped to England.

From twelve commercial lines sufficient seed was used to provide 10 lb. of experimental samples—divided into four groups, A, B, C, and D, which were treated as follows:—

A. Dried to approximately 5 per cent. moisture content and packed in lined sack.
B. Dried same as A—packed in unlined sack.
C. Undried—14–15 per cent. moisture content—packed in lined sack.
D. Undried—14–15 per cent. moisture content—packed in unlined sack.*

All seed was shipped in October, 1932, to the Official Seed Testing Station, Cambridge, England. Numbers 1 to 6, direct to England, arrived 29th December, 1932. Numbers 7 to 12, via the Australian coast and transhipment at New York, arrived 27th January, 1933. Samples of all lots were retained in storage in New Zealand as controls. Tabulated results are shown in Table 3.

* Normal shipment conditions.

Table 3.—Chewings Fescue (1932 Season): Trial Shipments of Dried and Undried Seed to Cambridge, England, September, 1932.

Mark.	September, 1932.		January, 1933.			January, 1933.			
	New Zealand, when packed.		Cambridge, on Arrival.		Loss during Transit.	New Zealand Controls.		Loss during Storage in New Zealand.	Approximate Loss due to Shipment.
Column 1.	Column 2.	Column 3.	Column 4.	Column 5.	Column 6.	Column 7.	Column 8.	Column 9.	Column 10.
	Moisture Content.	Germination.	Moisture Content.	Germination.	Germination.	Moisture Content.	Germination.		
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
A 1	6·7	92	9·99	82	10	9·9	86	6	4
2	5·0	94	9·50	89	5	9·3	91	3	2
3	5·5	91	9·19	75	16	9·2	80	11	5
4	6·0	96	9·40	94	2	9·5	96	0	2
5	5·3	94	9·25	88	6	9·5	96	0	6
6	6·1	94	9·32	92	2	9·2	95	0	2
7	4·2	93	9·60	89	4	8·8	87	6	0
8	6·2	98	9·99	95	3	9·7	96	2	1
9	4·4	94	9·35	87	7	9·3	92	2	5
10	7·1	97	9·93	90	7	9·2	90	7	0
11	5·6	96	9·72	93	3	9·7	94	2	1
12	5·1	92	9·57	80	12	9·4	79	13	0
B 1	6·7	94	14·40	46	48	11·4	84	8	40
2	5·0	94	14·07	61	33	11·3	91	3	30
3	5·5	91	14·47	48	43	11·1	71	20	23
4	6·0	96	14·73	85	11	11·3	94	2	9
5	5·3	94	13·35	73	21	11·1	95	0	21
6	6·1	94	13·45	66	28	12·0	89	5	23
7	4·2	93	13·63	59	34	10·9	83	10	24
8	6·2	98	13·12	75	23	11·4	97	1	22
9	4·4	94	13·16	75	19	11·0	86	8	11
10	7·1	97	12·88	68	29	11·5	95	2	27
11	5·6	96	13·10	72	24	11·4	90	6	18
12	5·1	92	13·18	59	33	11·2	74	18	15
C 1	15·2	92	15·63	32	60	13·0	56	34	26
2	15·8	95	15·82	46	49	13·4	74	21	28
3	15·2	90	15·52	36	54	13·2	66	24	30
4	15·3	97	15·61	70	27	13·0	94	3	24
5	15·5	97	15·58	58	39	13·1	85	12	27
6	15·1	96	15·45	54	51	12·8	75	21	30
7	14·8	91	14·63	30	61	12·8	67	24	37
8	15·3	98	14·93	42	56	13·1	76	22	34
9	15·6	94	15·14	28	66	13·2	73	21	45
10	15·2	97	14·85	38	59	13·1	83	14	45
11	13·8	97	14·88	45	52	13·2	82	15	37
12	14·1	88	14·68	31	59	13·0	68	20	39
D 1	15·2	92	16·03	38	54	12·5	79	13	41
2	15·8	95	16·05	57	38	12·4	87	8	30
3	15·2	90	15·49	46	44	12·3	72	18	26
4	15·3	97	15·67	75	22	11·9	92	5	17
5	15·5	97	15·33	72	25	12·4	83	14	11
6	15·1	96	15·27	52	44	11·6	83	13	31
7	14·8	91	15·38	49	42	12·2	79	12	30
8	15·3	98	15·25	64	34	12·2	94	4	30
9	15·6	91	15·40	46	45	12·2	83	8	37
10	15·2	97	15·14	59	38	12·3	87	10	28
11	13·8	97	15·35	54	43	12·3	87	10	33
12	14·1	88	14·85	40	48	12·3	71	17	31

From a study of column 6 it is obvious that the transit losses for the A lines were quite inconsiderable compared with those for B, C, and D, which, irrespective of the shipment route, lost heavily. The storage losses in New Zealand (column 9) for the A lines are approximately equal to the transit losses even for the three low vitality lines A 1, 3, and 12, but considerably less than the losses in B, C, and D. The heaviest falls are shown by C (undried—lined sack), which are undoubtedly due to the fact that the seed was packed with rather a high moisture content (15 per cent.) and that during subsequent rises in temperature this moisture has been unable to escape. Although the moisture content of the shipped C lines, as would be expected, remained constant, a fall of approximately 2 per cent. is shown for the New Zealand controls, due probably to the fact that when samples were drawn and weighings made the atmospheric humidity was low and immediate moisture losses occurred.

Upon the completion of the first series of tests at Cambridge all samples were placed in storage and further tested in three months and again in six months. The results of these two series of tests, together with those for the New Zealand controls, are tabulated in Table 4.

Table 4.—Chewings Fescue (1932 Season) : Storage Results on Trial Shipments to Cambridge, England.

(A, dried ; lined sack. B, dried ; unlined sack. C, undried ; lined sack. D, undried ; unlined sack.)

Mark.	Germination Capacity.				Deterioration.				Relative Shipment and Control Samples.
	New Zealand, when packed, September, 1932.	England, on arrival, December, 1932.	England, Three Months' Storage. April, 1933.	England, Six Months' Storage, August, 1933.	During Transit.	England, during Storage, December to August.	England, Total Transit plus Storage.	New Zealand, Controls, October, 1932, to August, 1933.	
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1 A	92	82	82	71	10	11	21	15	6
B	94	46	46	35	48	11	59	32	27
C	92	32	28	20	60	12	72	51	21
D	92	38	36	26	54	12	66	42	24
2 A	94	89	88	81	5	8	13	12	1
B	94	61	60	42	33	19	52	30	22
C	95	46	38	33	49	13	62	47	15
D	95	57	52	45	38	12	50	32	18
3 A	91	75	72	73	16	2	18	17	1
B	91	48	44	37	43	11	54	45	9
C	90	36	25	13	54	23	77	58	19
D	90	46	35	35	44	11	55	46	9
4 A	96	94	94	88	2	6	8	4	4
B	96	85	81	77	11	8	19	11	8
C	97	70	61	61	27	9	36	25	9
D	97	75	68	62	22	13	35	17	18
5 A	94	88	90	88	6	0	6	5	1
B	94	73	72	70	21	3	24	14	10
C	97	58	55	48	39	10	49	34	15
D	97	72	66	62	25	10	35	20	15
6 A	94	92	89	78	2	14	16	7	9
B	94	66	57	54	28	12	40	26	14
C	96	45	31	23	51	22	73	53	20
D	96	52	45	33	44	19	63	34	29

Table 4—continued.

Mark.	Germination Capacity.				Deterioration.				Relative Shipment and Control Samples.
	New Zealand, when packed, September, 1932.	England, on arrival, December, 1932.	England, Three Months' Storage, April, 1933.	England, Six Months' Storage, August, 1933.	During Transit.	England, during Storage, December to August.	England, Total Transit plus Storage.	New Zealand, Controls, October, 1932, to August, 1933.	
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
7 A	93	89	81	82	4	7	11	11	0
B	93	59	52	48	34	11	45	28	17
C	91	30	24	16	61	14	75	45	30
D	91	49	47	37	42	12	54	29	26
8 A	98	95	94	92	3	3	6	7	1
B	98	75	65	60	23	15	38	23	15
C	98	42	29	26	56	16	72	45	27
D	98	64	55	46	34	18	52	26	26
9 A	94	87	88	91	7	4	3	8	5
B	94	75	69	64	19	11	30	14	16
C	94	28	24	16	66	12	78	41	37
D	91	46	48	36	45	10	55	30	25
10 A	97	90	88	86	7	4	11	12	1
B	97	68	74	67	29	1	30	26	4
C	96	38	33	25	58	13	72	37	35
D	97	59	56	49	38	10	48	27	21
11 A	96	93	91	85	3	8	11	9	2
B	96	72	66	61	24	11	35	23	12
C	97	45	34	25	22	20	72	43	29
D	97	54	52	42	43	12	52	31	21
12 A	92	80	80	79	12	1	13	13	0
B	93	59	54	50	34	9	42	34	8
C	89	51	30	21	58	10	67	43	34
D	88	40	38	26	48	14	62	40	32

It is evident that transit deterioration does not continue at the same rate after the seed is taken into storage and that after a period of six months only the A lines (dried, in lined sacks) show a germination capacity which might be considered reasonable for merchantable seed. It may be observed also that there is some inequality among the different lines of seed, and that, although storage conditions were identical, the degree of fall is by no means consistent. In this respect the best lines are Numbers 4, 8, and 11, and the three poorest Numbers 1, 3, and 12. All these lines were, of course, provided by the 1932 harvest, which, as previously stated, was a notoriously poor one. Even under storage in New Zealand, deterioration for all lots was more rapid than was expected.

As far as the A lots are concerned, it is probable that moisture was taken up during the short periods occupied in sampling, and that the fall in subsequent months would partly be due to this fact.

Experiment II: To ascertain Effect of Cool Storage.

Three full sacks of 1932 seed were shipped in January, 1933, to the United States Department of Agriculture at Washington. One sack (C 1) was lined with a commercial moisture-proof lining and shipped in cool storage, the second (C 2) without lining in cool storage, and the third unlined in hold storage. Test results are shown in Table 5.

Table 5.—Chewings Fescue (1932): Germination, 89 per Cent.; Moisture Content, 14·1 per Cent.; Experimental Shipment of One Line, Cool and Hold Storage, January, 1933.

Mark.	Storage during Shipment.	On Arrival, United States of America.		Loss in Germination during Transit.	Loss in Germination in New Zealand Controls.
		Moisture Content.	Germination.		
		Per Cent.	Per Cent.	Per Cent.	Per Cent.
C 1	Cool storage: Lined sack	15·3	81	8	6
C 2	Cool storage: Unlined sack	15·2	81	8	7
C 3	Hold storage: Unlined sack	13·5	64	25	7

As the seed was twelve months old when shipped and was rather below average in germination at that time, a loss of more than 25 per cent. might have been expected. Under cool-storage conditions, however, the transit loss was no greater than for the controls. The use of a lining in C 1 was not justified by the results.

Experiment III: To ascertain Effect of Cool Storage—Extension of Experiment II.

In co-operation with a New Zealand exporting house, arrangements were made for a commercial shipment of 1933 seed to be sampled on arrival in the United States of America and samples tested at the United States Department of Agriculture at Washington. The shipment was divided into four and shipped as shown in Table 6.

Table 6.—Chewings Fescue (1933 Crop): Commercial Shipment, May, 1933, Cool Storage and Hold Storage.—Samples tested at Washington and New Zealand. (Germination at Time of Shipment, 98 per Cent.)

Mark.	Storage during Shipment.	On Arrival.	
		Moisture Content.	Germination.
		Per Cent.	Per Cent.
WO–A	Refrigerating-chamber, 18° F. ..	13·8	94
OM–A	Domestic chamber, 27° to 30° F. ..	13·6	92
EG–A	Vegetable chamber, 30° to 36° F. ..	13·6	93
AT–A	Ordinary hold	12·5	92

The line was obviously typical of the superior 1933 crop, and, in consequence, only slight differences were apparent between the germination capacity of the cool-storage and hold-stowed lots. Furthermore, for this shipment the lower temperatures show no significant advantages.

Experiment IV: To compare the Behaviour of Stook- and Stack-threshed Seed and the Effect of drying and shipping in Sealed Containers.

Lots of seed of the 1932 harvest, from twelve commercial lines representing six threshed from stack and six from stook, were selected and shipped to the United States Department of Agriculture at Washington in October, 1932. Six of each group were forwarded in ordinary hold storage and six dried to approximately 6 per cent. moisture content and stored in metal cans. The results are shown in Table 7 (next page).

Table 7.—Chewings Fescue (1932 Crop): Forwarded October, 1932, to Washington, United States of America.—Stook- and Stack-threshed, Dried and Undried.

Mark.	Threshed.	Transit Storage.	Germination Capacity.				
			Initial, New Zealand.	On Arrival, United States of America.	Loss during Transit.	United States of America, after Six Months.	Total Loss after Shipment.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
TD	Stack	Hold ..	94	40	54	11	83
TR	,,	,, ..	99	57	42	34	65
EK	,,	,, ..	98	58	40	22	76
OG	,,	,, ..	94	33	61	12	82
ST	,,	,, ..	97	73	24	54	43
TD	Stack	Dried to 6 per cent. and stored in metal cans	96	87	9	74	22
TR	,,		98	94	4	89	9
EK	,,		98	90	8	86	12
OG	,,		95	72	23	57	38
ST	,,		97	94	3	91	6
BW	Stook	Hold ..	95	42	53	20	75
AZ	,,	,, ..	97	57	40	25	72
AH	,,	,, ..	98	77	21	42	56
ND	,,	,, ..	97	40	57	17	80
YB	,,	,, ..	96	70	26	60	36
BW	Stook	Dried to 6 per cent. and stored in metal cans	97	87	10	81	16
AZ	,,		96	90	6	93	4
AH	,,		98	95	3	93	5
ND	,,		97	85	12	75	22
YB	,,		97	94	3	95	2

NOTE.—Moisture content of composite samples on arrival: Hold, 12·3 per cent.; dried, 7·33 per cent.

There is no evident superiority of the stack-threshed samples; in fact, although no direct comparisons can be made, the stook-threshed lots appear to have carried more satisfactorily. It is very evident that the series included several lines of low vitality—*e.g.*, TD, OG, BW, and ND. The results of each of these as dried and undried lots should be compared in the table. In every case, however, the dried lots gave definitely superior results.

Experiment V: To determine the Effect on Transit Deterioration of—(a) Manurial Treatment, (b) Period of Cutting, (c) Drying to approximately 5 per Cent. Moisture Content, (d) drying to approximately 9 per Cent. Moisture Content, (e) Cool Storage.

The seed for this experiment was specially grown on the Department's experimental area at Gore, Southland, and up to the time of the consignment of the seed to the Seed-testing Station at Palmerston North the experiment was under the control of Mr. R. B. Tennent, then Fields Superintendent, Department of Agriculture, Dunedin, in co-operation with Mr. A. W. Hudson, Crop Experimentalist, Plant Research Station, Palmerston North. Details as to the growing and harvesting of the trial plots are as follow: Seed was sown in October, 1931, at the rate of 20 lb. per acre with 2 cwt. superphosphate. The resultant sward was top-dressed in September, 1932, at following rates: I, no manure; II, superphosphate 2 cwt. per acre; III, superphosphate 2 cwt. plus sulphate of ammonia 2 cwt. per acre; IV, superphosphate 2 cwt. plus sulphate of ammonia 2 cwt. plus 30 per cent. potash 2 cwt. per acre; V, sulphate of ammonia 2 cwt. per acre. The crop harvested in 1933 in three stages: (1) At barely ripe stage, 12th January, 1933; (2) at ripe stage, 16th January, 1933—seed shedding slightly; (3) at overripe stage, 18th January, 1933—seed shedding freely.

The crop was a heavy one and returned a high yield—a general average of 1,346·3 lb. per acre off the mill. Sufficient of the seed was available to allow of division into 5 lb. working-samples after dressing, which was carried out by the Station's " Clipper " cleaner.

The seed as shipped consisted of four series each of fifteen samples in groups of five representing as units first, second, and third cuts and a complete manurial series of five treatments. Series Bx represents seed dried to 5 per cent., but with available facilities it was found impossible to prevent the overdrying of some lots and the taking-up of moisture by others. These remarks apply also to the Cx series planned to be dried to 9 per cent. moisture content. These inconsistencies, however, apparently have not affected results. Series Bx and Cx were packed in two separate lined sacks. Series As represents undried samples forwarded in cool storage; and series Ax undried controls under ordinary hold conditions. Results are presented in Table 8. The seed was shipped in October, 1933, via the Australian Coast and the East Coast of the United States of America to Cambridge, England.

Table 8.—Chewings Fescue (1933 Crop): Trial Shipments to the Official Seed-testing Station, Cambridge, England. Shipped October, 1933. Received in England 20th January, 1934.

No.	Production.		New Zealand at Shipment.		England, on Arrival.		New Zealand, Storage Control.		Germination Loss during Transit.
	Manurial Treatment.	Stage of Cutting.	Moisture Content.	Germination.	Moisture Content.	Germination.	Moisture Content.	Germination.	
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Bx 1	I	First	5·8	93	8·8	94	7·8	93	0
2	II	,,	6·9	93	8·7	94	8·1	92	0
3	III	,,	8·2	94	9·4	94	8·2	93	0
4	IV	,,	7·9	92	9·1	95	8·0	93	0
5	V	,,	7·2	92	9·6	92	7·8	92	0
6	I	Second	7·4	95	8·9	98	8·4	94	0
7	II	,,	4·6	95	8·9	97	7·5	95	0
8	III	,,	4·8	95	8·9	96	7·2	90	0
9	IV	,,	5·2	94	9·1	94	8·1	96	0
10	V	,,	4·2	94	8·6	95	7·2	96	0
11	I	Third	3·3	92	8·8	94	7·2	93	0
12	II	,,	4·6	94	8·4	97	7·3	94	0
13	III	,,	3·8	94	9·5	98	7·6	96	0
14	IV	,,	3·7	95	9·5	96	7·6	96	0
15	V	,,	3·9	96	10·0	97	7·4	98	0
Cx 1	I	First	7·9	93	11·8	91	9·8	93	2
2	II	,,	8·1	93	11·5	90	9·9	93	3
3	III	,,	8·1	94	11·7	93	10·0	96	0
4	IV	,,	7·8	94	11·4	93	9·9	93	1
5	V	,,	8·5	92	11·4	93	9·9	92	0
6	I	Second	6·5	95	11·0	93	9·3	97	2
7	II	,,	10·3	95	11·4	94	10·6	96	1
8	III	,,	10·9	93	11·7	93	10·9	95	0
9	IV	,,	9·6	94	11·4	94	10·1	96	0
10	V	,,	10·0	96	11·8	95	10·2	97	1
11	I	Third	10·3	94	11·4	96	10·5	94	0
12	II	,,	10·4	96	11·7	95	10·4	94	1
13	III	,,	9·8	95	11·5	93	9·9	96	2
14	IV	,,	9·6	95	11·7	94	10·1	95	1
15	V	,,	10·2	95	11·8	96	10·3	94	0
As 1	I	First	14·0	93	14·4	80	11·3	93	13
2	II	,,	14·1	94	14·2	80	11·7	90	14
3	III	,,	14·0	94	14·4	82	12·1	90	12
4	IV	,,	14·0	91	14·3	80	11·8	93	11
5	V	,,	14·0	92	14·3	80	11·7	93	12

Table 8—continued.

No.	Production.		New Zealand at Shipment.		England, on Arrival.		New Zealand, Storage Control.		Germination Loss during Transit.
	Manurial Treatment.	Stage of Cutting.	Moisture Content.	Germination.	Moisture Content.	Germination.	Moisture Content.	Germination.	
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
As 6	I	Second	14·1	93	14·2	84	12·2	94	9
7	II	,,	14·5	95	14·9	86	11·5	94	9
8	III	,,	14·1	93	14·9	88	11·6	95	5
9	IV	,,	14·1	94	14·3	87	11·8	95	7
10	V	,,	14·1	94	14·4	90	12·0	94	4
11	I	Third	14·1	93	14·2	91	12·4	95	2
12	II	,,	14·2	94	14·2	92	12·5	96	2
13	III	,,	14·2	94	14·5	90	12·1	94	4
14	IV	,,	14·5	95	14·2	93	11·8	98	2
15	V	,,	14·1	95	14·8	91	12·7	95	4
Ax 1	I	First	14·0	93	13·4	83	11·3	93	10
2	II	,,	14·1	94	13·5	80	11·7	90	14
3	III	,,	14·0	94	13·5	83	12·1	90	11
4	IV	,,	14·0	92	13·4	87	11·8	93	5
5	V	,,	14·0	93	13·2	84	11·7	93	9
6	I	Second	14·1	93	13·4	86	12·2	94	7
7	II	,,	14·5	95	13·7	88	11·5	94	7
8	III	,,	14·1	94	13·5	87	11·6	95	7
9	IV	,,	14·1	95	13·5	88	11·8	95	7
10	V	,,	14·1	94	13·6	92	12·0	94	2
11	I	Third	14·1	94	14·1	92	12·4	95	2
12	II	,,	14·2	93	13·9	91	12·5	96	2
13	III	,,	14·2	94	14·0	91	12·1	94	3
14	IV	,,	14·5	95	13·5	94	11·8	98	1
15	V	,,	14·1	95	13·7	94	12·7	95	1

Viewed merely as a shipment of seed, this experiment was undoubtedly successful, but notwithstanding the prolonged shipment on a usually unfavourable route only slight deterioration in the controls occurred. This was due not only to the fact that the seed was harvested in an unusually favourable season, but also to the fact that the seed was grown on land of a much higher fertility than the average "fescue country," and in consequence all lots, irrespective of production technique, were of a very high vitality. However, the seed has not yet completed the six months' period of storage, and one is hopeful that vitality of the controls at least will have become lowered.

A review of the data as tabulated indicates that of the four series Ax (6 per cent. moisture content) shows no transit losses, that the losses for Cx (9 per cent. moisture content) are scarcely significant, that for As (cool storage) deterioration is apparent, and for Ax deterioration is approximately equal to that for As. Manurial treatment does not appear to have affected results. On the other hand, the deleterious effect of early cutting is observable in series As and Ax (Numbers 1–5), the second and third cuts giving progressively superior results. These differences will probably become more evident following storage.

A point of interest is the evening-up of the moisture content in Bx from a range of 3·7 per cent. to 8 per cent. to a level of approximately 9·5 per cent., and in Cx from a range of 6·5 per cent. to 10·9 per cent. to a level of approximately 11·5 per cent. A certain amount of moisture would be taken up during packing, and after sealing the available moisture has been absorbed proportionally to a consistent level. As the linings were quite moisture-proof, one can but assume that the moisture-content percentage as shown by Cambridge are those pertaining during transit, especially as those for the New Zealand controls are approximately equal.

As stated, further tests after a period of storage will be made at Cambridge, and on receipt of these results this experiment will be further reviewed.

Discussion.

From the evidence presented herein it will be concluded that seed-drying offers the most satisfactory means of overcoming transit deterioration and that seed so treated will retain vitality for at least six months after delivery. Perfectly dry seed will store for a very long period: there is at the moment under test at this Station a sample of ten-year-old Chewings fescue seed which shows a growth of 75 per cent. This has been stored in a desiccator over calcium chloride and for seven years germinated over 90 per cent. The undried portion of the sample had completely lost vitality in two years and a half.

Seed-drying as carried out in various parts of the world, principally with grain, consists in the removal of excess moisture and is known as "conditioning." The grain is then stored at or near its normal moisture content. The drying of fescue, however, consists of the removal of approximately half the normal moisture content, and obviously if the seed is stored under average atmospheric conditions moisture will be taken up until the normal level is attained. It is this fact which is responsible for the difficulties which attend to the shipping of dried seed. It is not sufficient that the seed be dried, but that it be kept dry for the period of shipment and storage. Reference to Table 3 shows that dried seed in ordinary sacks shipped only to a slight extent more satisfactorily than undried, so that under these circumstances drying alone is not economically sound. The question, therefore, centres on suitable moisture-proof containers, which would conveniently be in the form of sack linings. For experiments Nos. 1 and 5 rubberized cloth linings were ordered to specification and used with success, but the cost would be prohibitive for use with ordinary commercial shipments. A number of proprietary sack linings were imported, but none were found to be sufficiently proofed to prevent the ingress of moisture. It is considered, however, that as these types of linings are designed for the storage of normally dry products — that is, as a protection against excessive moisture—the manufacturers possibly would consider the preparation of special linings for seed. The writer is at present in communication with certain firms with this end in view. There are other types of containers in which seed might be stored, but sack storage offers many advantages, the chief of which is economy and convenience. Probably the only disadvantage is the possibility of the too free use of hooks during handling in and out of store, rail, and ship.

The experimental drying was carried out in cabinet dryers heated by gas, but this type of apparatus would be quite unsuitable for bulk lines, which would require to be fed automatically and delivered into the containers and sealed while warm. In North America and in Europe there are in use a number of grain-dryers which mostly utilize heated air as the drying agent and which could be adopted for the drying of grass-seed. The rapidity of the removal of moisture depends, of course, not only on the temperature but also on the volume of air which can be passed, preferably, through layers of seed. The air may be heated by means of steam coils, electrically heated coils, coke, coal, or oil furnaces.

Nothing can be said here as to the cost of artificial drying, which must necessarily add to the export price of the seed. Presumably, however, seed of a guaranteed germination capacity would be sold at a premium. Furthermore, there are the losses in weight occasioned by the removal of a portion of the contained water, which, when the seed is in the undried state, costs money. Therefore, a minimum amount of moisture would be removed, say, 5 per cent. to 6 per cent.

The available information in respect of cool storage is not extensive, but it is evident that it offers possibilities. Artificial drying with special packing as a safeguard against deterioration during transit and storage is definitely superior, but should this method prove uneconomic or for any other reason inoperative, then cool storage provides a second line of defence. It would seem that there are possibilities in its employment for early shipments of seed intended for early sowing. It is intended to institute experiments designed to elucidate this point and also ones in regard to the most suitable storage temperatures.

Conclusion.

This work, necessarily limited by facilities, has been brought to the point of demonstrating the causes of deterioration not only in Chewings fescue, but also in other grass-seeds, and of showing that it is possible to overcome severe losses in viability. The work is being continued as before on a trial scale, the result of which can be used only as a basis for the treatment and storage of bulk commercial shipments. Attention here will be concentrated on the question of suitable sack linings and further drying experiments, it being the writer's contention that the future of the Chewings fescue export trade is dependent mainly upon seed-drying.

It is true that the success of laboratory results is not always so evident in commercial practice, and for this reason large-scale drying should not be attempted until trials have been made using a small-scale automatic dryer. The matter is plainly now one for the industry itself, and it is the writer's opinion that exporters and growers should co-operate in providing an experimental drying-plant. A certain amount of data concerning drying, storage, &c., has been accumulated, and will be available.

Acknowledgments.

Grateful acknowledgment is made to various seed exporting houses—more particularly Messrs. J. E. Watson and Co., Ltd., of Gore and Invercargill, Messrs. A. S. Paterson and Co., Ltd., Dunedin, Messrs. Wm. E. Reynolds and Co., Dunedin—for their interested co-operation in experimental work; to the Official Seed-testing Station, Cambridge, England, and the Division of Seed Investigations, United States Department of Agriculture, Washington, D.C., U.S.A., for their valued assistance in receiving, testing, and storing various experimental parcels of seed; to the New Zealand Manager, Canadian National Steamships, Wellington, for providing special stowage-space ocean freight free; and to Mr. E. O. C. Hyde, Assistant Seed Analyst, for his assistance with the experimental work referred to herein.

POTATO TRIAL AT PALMERSTON NORTH, 1933-34.

A REPORT ON THE GROWING OF FORTY-EIGHT LINES OF COMMERCIAL SEED POTATOES.

J. H. CLARIDGE, Assistant in Agronomy, Plant Research Station, Palmerston North.

IN 1933 the Fields Division undertook the trial of a number of samples of commercial seed potatoes, with the object of determining the variations which exist between different lines of seed. This step was taken as a result of complaints having been received in regard to the table quality of certain potatoes grown in the North Island,

FIG 1. PLOTS OF SOME OF THE COMMERCIAL SAMPLES RECEIVED FROM GROWERS UNDER THE NAME OF IRON DUKE.

On the left a moderately vigorous line, which was identified as Northern Star. In the centre another line identified as Northern Star, but so badly diseased as to be worthless. On the right is quite a good line of the Iron Duke variety.

There was little to differentiate these samples when being planted.

particularly in relation to the physiological condition known generally as brown fleck. The trial was conducted at the Plant Research Station (Palmerston North), and growers in the Wellington Province were invited to submit samples (seventy-five tubers) of their commercial seed.

As a result forty-eight samples were forwarded for trial. Of these, six samples represented seed which had been produced in the South Island in 1932–33. In addition, four lines of certified seed were obtained by the Department itself from the South Island; these were

used for control purposes. Actually, therefore, ten out of fifty-two samples tried out were South Island grown (nine of them being the produce of certified crops). Thus, although the trial was primarily confined to potatoes grown in the Wellington District, the results have a bearing on potato-growing over the whole of the North Island and parts of the South Island.

The purposes of the trial were twofold: firstly it was an investigation into the incidence of brown fleck condition in relation to variety, while a secondary purpose was to compare the relationship between the percentage of virus infection present and the yields obtained in the trials.

The samples received were divided into two lots—fifty tubers were planted in two rows each of twenty-five tubers, while the remaining twenty-five tubers were cut and examined at time of planting for any sign of flesh discoloration. Notes were made during the season on such points as varietal purity and virus infection. When mature, the tubers were dug and weighed, two from each plant being cut and examined for flesh discoloration.

The results are given in the following table:—

Table of Results.

Row No.	Percentage of Brown Fleck in Tubers.		Percentages of			Yield in Tons per Acre.	Comments.
	Planted.	Dug.	Misses.	Foreign Varieties.	Diseased Plants.		
Aucklander Short Top.							
101 ..	..	..	..	..	4	14·0	Once grown from certified seed.
45, 46	None cut	..	2	..	10	13·9	Control—South Island certified seed.
43, 44	..	..	..	..	6	13·5	South Island certified seed planted.
29, 30	None cut	..	..	..	..	12·9	Control—South Island certified seed.
39, 40	..	..	2	..	20	12·3	South Island certified seed planted.
27, 28	..	..	..	..	8	12·2	Once grown from certified seed.
35, 36	..	..	..	2	4	12·1	Once grown from certified seed.
51, 52	..	..	..	4	8	10·7	Uncertified seed.
21, 22	..	..	..	..	20	10·1	Twice grown from certified seed.
25, 26	..	2	4	4	12	10·0	Once grown from certified seed.
41, 42	..	..	2	8	2	9·9	Uncertified seed (ex South Island four years).
37, 38	..	2	4	..	12	9·9	Once grown from certified seed—original line rejected in following season.
49, 50	4	2	16	..	4	8·6	Three times grown from certified seed.
23, 24	..	..	14	8	22	6·5	Three times grown from certified seed.
33, 34	..	..	28	..	16	5·0	Uncertified seed (low yield due in part to tubers in poor condition when planted).
Mixed Lines (entered as Aucklander Short Top).							
47, 48	24	33	14	Mixed	14	9·8	Origin unknown.
31, 32	8	None cut	18	36	24	5·3	Supposed to be once grown from certified seed: first season grower has had line.
Aucklander Tall Top.							
55, 56	1 in 5 tubers	4	..	..	2	16·3	Control—South Island certified seed. May be some "outside row" effect increasing yield.
57, 58	4	6	..	..	6	14·9	South Island certified seed planted.
53, 54	24	38	..	..	4	14·2	South Island certified seed planted.
59, 60	40	14	16	..	62	6·7	Uncertified seed.

Table of Results—continued.

Row No.	Percentage of Brown Fleck in Tubers.		Percentages of			Yield in Tons per Acre.	Comments.
	Planted.	Dug.	Misses.	Foreign Varieties.	Diseased Plants.		
				IRON DUKE.			
71, 90	None cut	12	..	..	16	15·4	Control—South Island certified seed.
72, 73	4	5	6	2	28	11·0	Three times grown from certified seed.
84, 85	..	2	..	..	36	10·4	Origin unknown; entered as Aberbrothok.
93, 94	20	8	8	..	28	9·8	Three times grown from certified seed; entered as Aberbrothok.
86, 87	..	..	2	..	28	9·1	Three times grown from certified seed.
99 ..	None cut	4	4	..	48	6·7	Not certified; entered as Aberbrothok.
65, 66	32	None cut	16	..	84	0·3	Not certified.
				NORTHERN STAR.			
78, 79	28	21	..	..	18	13·5	Not certified; entered as Iron Duke.
95, 96	16	16	..	..	24	12·9	Not certified; entered as Aberbrothok.
80, 81	4	12	2	8	34	11·9	Not certified; entered as Aberbrothok.
76, 77	4	7	2	8	48	9·6	Not certified; entered as Iron Duke.
17, 18	4	18	..	..	52	9·3	Not certified; entered as Gamekeeper.
67, 68	56	20	..	2	42	8·3	Not certified; entered as Iron Duke.
74, 75	32	23	18	6	42	7·3	Not certified; entered as Aberbrothok.
19, 20	None cut	22	..	..	58	4·7	Not certified; entered as Unknown.
97, 98	32	8	6	8	72	4·6	Not certified; entered as Iron Duke.
63, 64	12	24	12	2	62	2·8	Not certified; entered as Aberbrothok.
91, 92	20	8	20	8	62	2·8	Not certified; entered as Aberbrothok.
82, 83	24	15	38	..	72	1·3	Not certified; entered as Aberbrothok.
				MIXED LINES (ENTERED AS IRON DUKE OR ABERBROTHOK).			
88, 89	4	13	2	Mixed	30	10·1	Mixed Northern Star, New Era, and Iron Duke.
69, 70	16	12	16	Mixed	46	6·4	Mixed Northern Star and New Era.
				NEW ERA.			
102, 103	40	18	2	18	4	14·2	Not certified; rogues are Northern Star.
15, 16	Not cut	45	18	6	34	5·4	Not certified; rogues are Northern Star.
13, 14	8	45	30	16	44	4·5	Not certified; rogues are Northern Star.
				DAKOTA.			
7, 8 ..	8	..	..	..	26	15·0	South Island certified seed planted.
5, 6 ..	12	..	..	..	30	14·3	South Island (uncertified) seed planted.
100 ..	..	..	..	..	4	11·3	Once grown from certified seed. Yield of this line upset by premature removal of tubers.
				KERR'S PINK.			
1, 2 ..	16	9	2	16	58	10·1	Three times grown from certified seed. May be some increase in yield due to "outside-row" effect.
3, 4 ..	6	8	4	..	70	6·2	Three times grown from certified seed.
				GREAT SCOT.			
11, 12	..	10	..	..	82	5·6	Three times grown from certified seed.
9, 10	8	10	6	..	66	5·3	Three times grown from certified seed.

Brown Fleck Investigation.

The facts emerging from the trial in relation to brown fleck are :—

1. There proved to be correlation between the proportion of brown fleck present in the tubers planted and in the tubers dug. This is amply demonstrated from a reference to the relative columns in the accompanying table.

2. The district of origin of the seed of any one variety had no influence on the incidence of brown fleck either in that seed or in the produce grown from such seed. No comment on this fact is required other than to draw attention to the information supplied in the table.

3. There was considerable variation in the incidence of brown fleck between one variety and another.

Of the varieties under trial, Aucklander Short Top showed itself to be relatively very free from brown fleck. Two lines, entered as Aucklander Short Top, and showing a comparatively high percentage of brown fleck condition, were discovered not to be pure Aucklander Short Top, but to be mixed with some other variety.

The Aucklander Tall Top showed considerable range in the incidence of brown fleck. One of the South-Island-grown lines of this variety was equally as badly affected as the North-Island-grown line.

Of eighteen lines entered under the name of Iron Duke (or Aberbrothok, as it has been commonly known in the Manawatu district) only six samples could be considered as being true to name. Two samples were very mixed, and the ten remaining samples were practically pure lines of the Northern Star variety. While neither of these varieties was by any means as free from brown fleck as was Aucklander Short Top, the affection in the lines of Northern Star was appreciably greater than in those of Iron Duke.

The Iron Duke variety has gained the reputation of being prone to brown fleck. From the results of this trial it would appear that this reputation has been due in no small part to the fact that so many lines of potatoes sold under this name have been in reality Northern Star, or mixtures comprising Northern Star, Iron Duke, and other varieties such as New Era.

Of the other varieties under trial the highest degree of affection appeared to be in New Era, while the samples of Dakota under test were relatively free from brown fleck.

Virus Infection and Yield.

Although this trial was not laid down with a view to determining accurately any small differences in either virus infection or yield, nevertheless the differences recorded have been so great as to fully justify their use in making comparisons. Readers should keep in mind, however, that small differences may be due to experimental error.

Several points of importance arise from an examination of the information obtained from this section of the trial.

The high correlation between the "disease count" and the yield per acre of the various lines is of great practical significance. In almost every instance an increase in the number of virus-diseased plants in a line is accompanied by a reduction in yield. This confirms previous trials undertaken of a similar nature.

An examination of the origin of the forty-eight lines under trial reveals that twenty-two of these can be traced back definitely to certified seed and twenty-three lines can be traced back to uncertified seed. The origin of three lines has not been determined. It will be noticed that in general those lines of certified origin have given the best yields. In addition, those lines furthest removed from certification are in general lower in yield than those which originated from seed certified in either the 1931–32 or 1932–33 season.

Thus in Aucklander Short Top the seven best lines (including the controls) are not more than once removed from certified seed. Of the

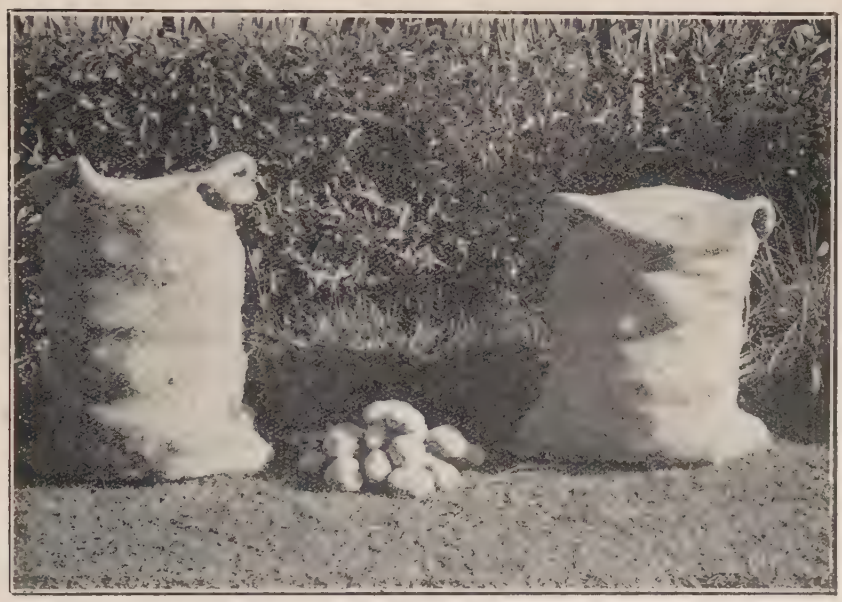

FIG 2. THE PRODUCE FROM THE THREE PLOTS SHOWN ABOVE.

Left: 11·9 tons per acre. Centre: 1·3 tons per acre. Right: 10·4 tons per acre.

The crop on the left, forwarded as Iron Duke, is actually Northern Star, and while satisfactory in respect to yield is lacking in quality because of brown fleck.

eight poorest lines, on the other hand, three originated from uncertified seed, two are three times removed from certified, one is twice removed, and two are once removed.

Support to the above remarks is given by an analysis of all the yields obtained, as given in the following table:—

Lines planted with—	Tons per Acre.
Certified seed averaged	14·3
Seed once grown from certified seed averaged..	11·6
Seed twice grown from certified seed averaged..	10·1
Seed three times grown from certified seed averaged	8·0
Uncertified seed averaged	7·6

The amount of deterioration exhibited more particularly in the lines of Kerr's Pink and Great Scot, which have been three times grown in the North Island from certified seed, is further evidence in support of the gradual degeneration due to the spread of virus disease which is likely to occur when conditions are suitable.

From the foregoing evidence one is justified in assuming that, in the lines under trial, a general deterioration is taking place, due to growing for a few seasons in the Wellington District. Growers in this district in particular, and in the North Island in general, would therefore be well advised to purchase certified seed from the South Island at frequent intervals.

It will be noticed from the table of results that in a number of cases the low yield would appear to be due to the high percentage of misses recorded. In computing yields no allowance has been made for tubers that did not grow. All lines received similar treatment, and it was considered that any line producing a high percentage of misses did not have the same "seed" value as one in which all the tubers planted produced shaws.

Conclusions.

1. Certain varieties appear to be more susceptible than others to the brown fleck condition, whereas the district in which the tubers were grown did not, from the evidence available, appear to have any influence on the degree of infection.

2. Correlation between virus disease and yield of tubers is shown.

3. The benefits derived from the use of certified seed are illustrated.

4. Many lines of potatoes being sold under the name of Iron Duke (Aberbrothok) are either of another variety altogether, or are badly mixed.

General.

The value of the use of certified seed is emphasized by the results of this trial. Some growers have purchased seed purported to be certified and have obtained discouraging results. Purchasers are reminded, therefore, that an official tag, attached to the sack, accompanies all lines of Government certified seed.

The co-operation of those supplying samples, and of the officers of the Fields Division who arranged for the collection of these, is acknowledged.

The Minister of Agriculture has appointed Mr. Albert Smith to be a member of the New Zealand Wool Committee, *vice* Mr. H. T. Milnes, resigned.

The Minister of Internal Affairs has announced that it has been decided that in future the first Wednesday in August each year shall be observed as Arbor day, and local bodies are requested to observe 1st August as Arbor Day this year.

The Instructor in Agriculture, Auckland, reports a labour-saving method in making the open drain connecting up mole drains. The drain-plough is drawn across the end of the mole drains twice, making two cuts as deeply as possible, the width apart that the drain is to be wide. The labour of digging the drain is thereby considerably lessened.

THE MISUSE OF LIME, WITH SPECIAL REFERENCE TO BUSH-SICK LANDS.

B. C. ASTON, Chief Chemist, Department of Agriculture.

THE most important effect of lime on soils is the lightening influence possessed by both ground limestone and caustic lime (quick and slaked lime) on heavy lands such as clays and some loams. Liming renders such a soil more easy to work; in fact, without previous liming it is an economic impossibility to cultivate some soils. The application of as much as 2 tons of quicklime has in the past been necessary to enable some tenacious clays to be worked in the South Island. This amount of lime may be computed as roughly equal to 4 or 5 tons of carbonate of lime (ground limestone).

In the North Island many of the loams are light, but respond well to a few hundredweight of ground limestone per acre applied in conjunction with phosphates as a pasture top-dressing. The function of lime here is to keep phosphate in an available condition for plant growth, to correct soil sourness (acidity), and to so improve the soil as a medium for crop or pasture growth that by competition the desired plants are stimulated to crowd out the unwanted weeds of low feeding-value such as sorrel and also to render the soil sweeter and therefore unfavourable for the growth of fungoid pests which attack crops, such as "finger and toe" or "clubroot." Lime also makes available certain reserves of plant-food which may be contained in either the organic (combustible) or the inorganic (incombustible) portion of the soil.

Another effect of lime is to make the pastures more suitable for cattle grazing by increasing the amount of clovers present. Plants of the family to which the clovers belong, the *Leguminosæ*, contain much more calcium than the grasses, the clovers containing up to 3 per cent. and lucerne up to 5 per cent. of lime, whereas the grasses contain less than 1 per cent. Lime therefore increases the calcium content of the pasture by increasing the proportion of clovers in it. Phosphates also have the same effect, but sometimes the combination of lime with phosphate is highly desirable to obtain the greatest response. It is important to bear in mind the general reasons for using lime in order to decide whether lime is, or under what condition it may be, useful as a dressing for bush-sick soils.

One of the most interesting and unexpected results in the early field experiments undertaken with a view to determining the effect of various top-dressings in mitigating or preventing bush sickness in ruminant stock was that lime applied either as carbonate or hydrate (slaked lime) to pasture had the effect of hastening the onset of the malnutrition symptoms in both sheep and cattle when compared with control animals on adjacent paddocks which had had no lime treatment. This experience has been repeated on every occasion where, under departmental control, lime has been used as a dressing for pasture. In addition to these official results, other farmers have observed the same ill result of top-dressing pasture with lime in even slightly bush-sick districts.

It may be also stated that at Mamaku farm no response in quantity or quality of pasture could be observed when strips of pasture were top-dressed with carbonate of lime at different rates per acre and compared with adjacent pasture on which no lime had been used, the quantities of lime used ranging from 1 to 4 tons per acre. The same lack of response to lime was also observed at Lichfield, on land very slightly bush-sick, and at Kaharoa, the most bush-sick of all lands. The soils upon which these results were obtained were technically pumiceous sandy silts or of even coarser texture, the particles in most cases being composed of air-borne pumice. Laboratory tests showed that, judging by the Hutchinson and McLennan and pH methods, the soil should have responded to lime, the lime requirement method showing 0·3 and 0·4 per cent., or, roughly, from 3 tons per acre of carbonate of lime absorbable, and the pH figure 5·5 indicating an amount of acidity or sourness which would warrant the soil chemist in advising the farmer to use lime for any but acid-tolerating plants such as potatoes and oats *if the soil was a normal one.* It was, however, very early recognized that pumice soils are highly abnormal in texture and composition and therefore should not be judged by methods of analysis and other laboratory tests which are applied to ordinary soils until these tests are confirmed by field experiments. Empirical laboratory methods for determining the lime requirement of coarse pumice soils were therefore early discarded as giving misleading results. It is obvious that there can be little advantage in applying lime to a soil which grows such abundance of clover, containing up to 3 per cent. of lime in the dry matter, and therefore indicating that the plant is able to absorb lime in quantity from the soil, and further indicating that it is present in the pasture in sufficient amount for stock. That there is no serious shortage of lime in the natural food of the animals of coarse pumice lands is also shown by the excellent development of the bones of an animal at all stages of its life, even when dying of bush sickness. Neither does it appear that ground limestone would do much to improve the mechanical state of such a soil. In pumice soils there is generally no great amount of "clubroot" or "finger and toe" in cruciferous crops, indicating that the soil as a medium for healthy growth of these crops does not require sweetening although an alkaline reaction is highly beneficial for turnip production. The only argument that can be advanced for the use of lime on pastures is that possibly more carbonate of lime in the soil might enable phosphate to be retained in an available state for a longer period than would be possible without such lime, but increased susceptibility of the animals to bush sickness is rather a high price to pay for such a theoretical objective. One of the great uses of lime is, of course, to lighten heavy soils and render them easy to work, but pumice soils are already too light in texture and suffer from a deficiency of colloidal mineral matter so that this argument for the use of lime cannot be applied to pumice soils. Moreover, in light sandy lands lime is known to induce chlorosis* in plants while the animals pastured on these plants

* For the purpose of this article it may be briefly explained that chlorosis is a condition which results in an unhealthy paleness in plants and animals.

suffer from progressive anæmia, possibly to be explained by the fact that in soils of very open texture lime has a prejudicial effect in decreasing the availability of the soil iron or upsetting the proper balance with other elements present.

Some interesting cases have, of recent years, come to light which confirm the opinion that lime carbonate is highly prejudicial on sandy soils either to the plants growing thereon or to the stock grazed on the plants. C. G. Dickinson, B.V.Sc., Veterinary Officer to the Tasmanian Government, stationed at Ulverston, Tasmania, wrote* in 1924 concerning a malnutrition disease, similar to bush sickness, known as "coastiness" occurring on King Island off the coast of Tasmania. The soil upon which the cattle became "coasty," analysed by Mr. H. J. Colbourn, Agricultural Chemist to the Tasmanian Government, contained 30 per cent. of carbonate of lime, the other constituents being described as follows: Phosphoric acid low, but sufficient to meet purpose of moderate crop, nitrogen abundant, potash fair. The chemist was inclined to think that the morbid condition of the stock was brought about by the very large quantity of carbonate of lime present. On the land at King Island where stock remained continuously healthy the soil also contained a large amount of organic matter, but the phosphoric acid and potash were not greatly different in amount from the unhealthy or "unsound" land. The carbonate of lime was, however, greatly less in quantity, being only 0·4 per cent. It must also be stressed that the unhealthy soil contained less than 2 per cent. clay, whereas the healthy soil contained 23 per cent. Other nearby sandy soils are described as containing less than 0·3 per cent. of carbonate of lime and from 8 to 18 per cent. clay, which are described as "semisound" or "sound." It certainly looks as if the lime here had a deleterious effect in conjunction with the sandy nature of the soil on the stock grazed on that area.

From the Veterinarian's report it would appear that the King Island malnutrition is probably the same as bush sickness in New Zealand since in both places (1) the prominent symptom is progressive anæmia; (2) the cattle can be cured by transferring to "sound" land; (3) the cattle show signs of the disease after being on unsound land for some months; (4) the cattle recover when put on to sound land, but do not increase in condition until put back on to unsound land. This is particularly the case with "coastiness," the cattle being changed about periodically until they are finally put on to the luxuriant growth on unsound land to fatten; (5) cattle on unsound land fed on fodder grown on sound land resist the disease for a very much longer period than otherwise they would do; (6) iron treatment of calves is efficacious in warding off the malnutrition in both diseases. It is to be observed that the soil of the unsound land is a grey sand, but that of the sound land is an ironstone gravel.

Almost at the antipodes of Tasmania another similar instance of a malnutrition disease in cattle and sheep was published in 1933 by Grigg and Dryerre (*Vet. Jour.*, 89, pp. 99–110). The conditions seem to be very similar to those occurring on King Island, Tasmania. The trouble is called "pine" in Scotland, and on one of the Inner Hebrides, Tiree, an island of some 34 square miles in area, the surface of

* Personal communication. (See also *Australian Veterinary Journal.*)

which consists of blown sands, rock, and raised beach, on the blown sands, which contain 50 to 60 per cent. of calcium carbonate in the form of broken sea-shells, "pine" develops, but is curable by changing the stock to the raised-beach type of soil, which contains lime equal to only 2.4 per cent. carbonate of lime and more than twice the amount of iron oxide that the blown sand contains. There does not appear to be a great difference in texture between the blown sand and the raised-beach types. The latter type is a gravelly soil or gravelly sand. The individual grains are often rust-stained and irregular iron-cemented layers or iron pan have been noted in some pits. The symptoms of the "pining" animals are those of the progressive debility accompanied by anæmia and emaciation and, in fact, are similar to those of bush sickness. The authors effected a cure of "pining" by dosing fourteen cattle with iron oxide and salt. Control animals having no iron became affected with "pine" malnutrition. The authors concluded that the administration of crude ferric oxide with or without the addition of dicalcic phosphate appears to be of specific curative and preventive value in "pine," and it appeared to them probable that the cause of "pine" is the deficiency of iron in the pasture and/or of "available" iron in the affected areas. "Pine," "vinquish," or "daising" also occurs in the Cheviot Hills of north Britain and as predicted by the writer in 1924 (*Transactions, New Zealand Institute*, Vol. 55, p. 723) that "pining" in Scotland, "coastiness" in King Island, "nakuruitis" in Kenya, and "bush sickness" in New Zealand would be found to have the same cause—namely, iron starvation—and in all of these cases it has been since found that the disease is curable by administration of iron licks or remedies.

In New Zealand bush sickness is not confined to the pumice sandy country whether inland or coastal, but no doubt occurs on the dune sands of the North Island sea littoral when sheep are confined to pure pasture on fixed dunes.

Having established the fact that malnutrition, of the bush-sickness type, in ruminants occurs in two widely separated stations on opposite sides of the world on sandy soils very rich in calcium carbonate—an unusual combination—it is not surprising that applications of lime on the bush-sick lands of New Zealand have not only failed to do good to pasture, but have actually done harm to stock. Unfortunately, when these experiments were initiated in New Zealand, there was no previous knowledge of anything similar anywhere else in the world from which one might derive guidance in the treatment of this remarkable New Zealand trouble in stock.

On reference to the *Journal* of this Department, it will be seen that from 1912 practically down to the present day, as a result of the experiments in the pumice lands, warnings have been issued to farmers from time to time against using lime for top-dressing pasture on coarse pumice lands. For drilling in the turnips in the seed and manure drill, on the other hand, lime has been recognized as a very useful amendment on the same lands. Thus on the 15th August, 1912, page 123, is stated, ". . . phosphates are known to have a good effect in mitigating the injurious effects of manganese compounds present in excess. Lime, it

is interesting to note, has the opposite effect*; and there is some evidence that lime has an injurious action on the feeding-quality of pasture on bush-sick lands."

On the 16th June, 1913, page 616, are recorded the results of experiments on animals grazed on paddocks differently top-dressed. Four sheep at Te Pu were put on a paddock top-dressed with quicklime, 1 ton per acre. All died in ten months. In the control paddock, however, sheep lived for a year. On a paddock top-dressed with basic slag three animals out of five died in ten months, the other two being killed by accident. At Mamaku similar results were obtained. On paddocks treated with lime alone, and lime and super, all sheep and steers were affected, the sheep all dying, while some sheep on the control paddock were not affected after two years' grazing.

On the 20th October, 1916, page 275, it was stated: "Basic slag alone,† though it produces an abundant growth of herbage, does not seem so suitable for combating bush sickness. . . ." This is probably due to the lime contained in it. Lime alone seems to do more harm than good in connection with bush sickness.

In *Transactions, New Zealand Institute*, 1924, Vol. 55, p. 720, in which an abstract on bush sickness work is published, the writer states: " . . . When bush-sick pasture is top-dressed with lime the animals become bush-sick sooner than on land which has had no treatment. This may be connected with the well-known fact that chlorosis of plants often occurs on sandy land having an excess of lime."

In the *Journal* for the 21st April, 1924, page 221, is stated: "Liming evidently has a good influence on the turnip crop, though its effect on bush-sick pasture is not apparent, and animals pastured on newly limed areas become bush-sick quicker than on untreated pasture."

In the *Journal* for the 20th June, 1924, page 386, is stated: " . . . It appears that soils which gave rise to malnutrition diseases in plants and animals are often soils of a loose texture and coarse nature, and frequently are alkaline owing to an excess of lime in the soil. It is significant that application of lime hydrate or carbonate as a top-dressing to pumice pasture lands causes ruminants pastured thereon to become bush-sick in a shorter time than they would on land not so treated.

In the "Proceedings of the Third Pan Pacific Science Congress, Tokio, 1926, page 2545, it is stated: "Applications of lime, whether as carbonates or burnt lime, cause the onset of the disease to be accelerated, and the animal dies much sooner than if pastured on untreated land."

The *Journal of Agriculture*, 20th August, 1927, page 100, states, " . . . For anything coarser than a silt it is best to keep the soil reaction acid, which inhabits the use of such alkaline dressings as are supplied by most forms of lime. There is no doubt that lime will have to be distributed on many North Island

* Kelly: "The Functions and Distribution of Manganese in Plants and Soils," Bull. 26, Hawaii Experiment Station, 1912. Also Guthrie and Cohen: *Agricultural Gazette*, New South Wales, pp. 125, 435, 1910

† Mixed with an equal part of super, slag is, however, the best fertilizer known for bush-sick lands, supplying iron to the soil in the cheapest and best form.

lands in increasing quantities in the future, but on the coarser pumice lands, it will not be good practice to apply lime for very many years; not only is lime now unnecessary but it is even harmful."

In *Transactions, New Zealand Institute,* Grimmett and Simpson, 1928, Vol. 59, page 399, state: "The series grown on the 'pining' soil offers the most interesting comparisons . . . The application of lime . . . has definitely depressed the percentage of manganese in the crop."

In the *Transactions, New Zealand Institute,* 1929, Vol. 60, page 47, it is stated: "Lime applied in amounts from 1 ton to 2 tons per acre to the pasture growing on sandy silt soils of the pumice type has given deleterious results to the stock. In fact, stock lose condition more quickly on limed land than on paddocks to which no treatment has been applied. This was confirmed by several experiments at Mamaku and Lichfield. It is a well-known fact in agricultural science that amelioration of sandy lands is better effected by the addition of organic manures than by lime."

In the *Journal of Agriculture* for February, 1932, page 109, it is stated: " . . . In the case of bush-sick pumice soils, lime at first has a deleterious effect on the stock pastured on lands recently limed . . . In field trials there is no appreciable response from the pasture. Clubroot and other troubles curable by lime are not generally present on pumice lands, although turnips are benefited by the addition of lime to the manure sown with the seed. The best fertilizer of all for both turnips and pasture is a mixture of basic slag and superphosphate."

The Quarterly Report to the Marketing Board to the 30th September, 1932, states: " . . . There have been excessive amounts of lime used on Morton Mains land and it is perhaps possible that this has caused more lime and manganese to be absorbed by the grasses than is good for the animal in its iron metabolism."

The Chief Chemist reported on visit to Rotorua, 11th October, 1922, that the treatment of bush-sick pasture with lime or limestone is not in practice found to be efficient but rather the reverse, the animals becoming bush-sick more quickly on limed pasture than on that which has received no treatment whatever. It is, however, highly probable that the liming of the turnip crop will be profitable. Better turnips were obtained on the land on which the pasture had been limed than on unlimed land, though no improvement could be noticed on the pasture, a close mat of Chewings Fescue, at Mamaku, which had been limed prior to breaking it up for turnips. In an experiment near Rotorua, a 40 ton crop of turnips was obtained by a settler of Malfroy Road, with lime sown with turnip manure and seed. An adjoining crop treated with the same seed and manure on the same kind of soil gave a very poor crop (about 8 tons).

In a memorandum to the Director of the Live-stock Division the Chief Chemist, under date of 6th December, 1922, states, *inter alia:* "On a limed paddock the stock become sick quicker than on pasture which is untreated."

(To be continued.)

HOT-WATER TREATMENT OF SEED OF BARLEY AND WHEAT.

I. CROP RESULTS WITH BARLEY IN CANTERBURY, SEASONS 1930 TO 1934.

C. H. HEWLETT and J. H. HEWLETT, M.A., Canterbury (N.Z.) Seed Co., Ltd., Christchurch, N.Z.

THE following report surveys another year's results of the work carried out by the Canterbury Seed Co., with the advice and assistance of Mr. J. C. Neill, Field Mycologist, Department of Agriculture. Below a comparison has been made between owners' seed and treated seed. The loss to the barley-grower through the practice of sowing his own seed is once more emphasized, although the number doing so has substantially decreased. Tables Nos. 1 to 2 show to what extent the quality of the crop was adversely affected.

Table 1.—Grading of Product of Treated Seed, 1934. (Average of all districts.)

Quality.	Chevalier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
No. 1 Grade ..	75·8	86·0	100·0	82·3	81·0
No. 2 Grade ..	18·9	12·2	..	16·4	15·9
Under grade ..	5·3	1·8	..	1·3	3·1
Totals	100·0	100·0	100·0	100·0	100·0
Number of fields ..	102	59	9	52	222
Acres	1,538	856	108	827	3,329

Table 2.—Grading of Product of Owner's Seed, 1934. (Average of all districts.)

Quality.	Chevalier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
No. 1 Grade ..	63·5	71·4	..	..	69·3
No. 2 Grade ..	36·5	28·6	..	..	30·7
Under grade ..	..	..	..	..	..
Totals	100·0	100·0	..	..	100·0
Number of fields ..	4	6	..	..	10
Acres	49	139	..	..	188

Tables Nos. 3 to 10, covering a period of five years, contain actual harvest results of "mill firsts," with a five-year average covering the whole period. The barley-grower in each district is thus supplied with detailed information both as to yield per acre and quality.

ELLESMERE.

Table 3.—Yield per Acre.

Year.	Number of Fields.	Acres.	Chevalier.	Spratt-Archer.	Gold-thorpe-Spratt.	Plumage Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	159	3,088	49·04	52·83	25·40	41·15	51·96
1931 ..	221	4,489	34·94	41·32	49·72	69·86	40·33
1932 ..	134	2,003	33·67	38·22	49·28	51·93	38·11
1933 ..	153	1,721	41·70	38·60	46·90	45·80	42·00
1934 ..	159	2,548	44·80	54·60	42·00	53·20	50·30
Totals ..	826	13,849	40·60	45·30	44·90	50·40	44·60
Number of fields ..	..	..	213	512	9	92	826
Acres ..	..	..	3,363	8,908	172	1,406	13,849

ELLESMERE.

Table 4.—Grading of Product (No. 1 Grade).

Year.	Number of Fields.	Acres.	Chevalier.	Spratt-Archer.	Gold-thorpe-Spratt.	Plumage Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	159	3,088	95·03	79·00	100·00	100·00	81·45
1931 ..	221	4,489	39·42	49·64	100·00	100·00	48·91
1932 ..	134	2,003	45·83	52·71	100·00	83·38	54·78
1933 ..	153	1,721	47·60	24·40	Nil*	28·90	32·10
1934 ..	159	2,548	76·50	88·40	100·00	84·60	83·30
Totals ..	826	13,849	62·20	62·90	56·30	67·70	63·30
Number of fields ..	..	..	213	512	9	92	826
Acres ..	..	..	3,363	8,908	172	1,406	13,849

* None passed as No. 1 Grade.

DUNSANDEL.

Table 5.—Yield per Acre.

Year.	Number of Fields.	Acres.	Chevalier.	Spratt-Archer.	Gold-thorpe-Spratt.	Plumage. Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	15	368	51·69	53·50	45·83	..	52·65
1931 ..	22	469	40·26	35·75	28·16	..	35·78
1932 ..	6	116	..	24·28	..	..	24·28
1933 ..	8	122	45·50	23·80	..	54·40	39·40
1934 ..	18	313	40·40	46·80	..	52·70	45·60
Totals ..	69	1,388	42·30	40·30	38·50	53·40	41·80
Number of fields ..	..	..	18	42	3	6	69
Acres ..	..	..	261	936	60	131	1,388

DUNSANDEL.

Table 6.—Grading of Product (No. 1 Grade).

Year.	Number of Fields.	Acres.	Chevalier.	Spratt-Archer.	Gold-thorpe-Spratt.	Plumage Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	15	368	100·00	80·66	100·00	..	83·61
1931 ..	22	469	87·04	26·57	Nil*	..	32·13
1932 ..	6	116	..	46·02	..	..	46·02
1933 ..	8	122	69·20	Nil*	..	100·00	64·60
1934 ..	18	313	69·20	Nil*	..	100·00	73·20
Totals ..	69	1,388	63·90	53·80	69·50	75·90	59·00
Number of fields ..	..	..	18	42	3	6	69
Acres ..	..	..	261	936	60	131	1,388

* None passed as No. 1 Grade.

LINCOLN.

Table 7.—Yield per Acre.

Year.	Number of Fields.	Acres.	Chevalier.	Spratt-Archer.	Gold-thorpe-Spratt.	Plumage Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	48	571	53·77	53·08	36·63	34·42	50·60
1931 ..	52	771	52·65	42·03	33·38	51·62	44·97
1932 ..	42	365	46·45	35·56	32·63	..	39·14
1933 ..	42	361	53·50	37·40	62·60	49·20	49·30
1934 ..	55	656	53·30	60·30	40·70	49·60	52·50
Totals ..	239	2,724	52·50	44·80	39·80	46·70	47·80
Number of fields ..	..	..	114	85	30	10	239
Acres ..	..	..	1,202	1,078	297	147	2,724

LINCOLN.

Table 8.—Grading of Product (No. 1 Grade).

Year.	Number of Fields.	Acres.	Chevalier.	Spratt-Archer.	Gold-thorpe-Spratt.	Plumage Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	48	571	81·98	71·10	100·00	100·00	78·45
1931 ..	52	771	91·21	61·95	62·19	Nil*	67·99
1932 ..	42	365	70·52	5·00	46·74	..	40·29
1933 ..	42	351	57·90	15·90	92·50	52·30	52·90
1934 ..	55	656	80·30	56·30	100·00	77·90	78·60
Totals ..	239	2,724	78·30	53·60	82·80	50·10	68·00
Number of fields ..	..	..	114	85	30	10	239
Acres ..	..	..	1,202	1,078	297	147	2,724

* None passed as No. 1 Grade.

SUMMARY OF DISTRICTS, 1930, 1931, 1932, 1933, 1934.

Table 9.—Yields per Acre.

District.	Number of Fields.	Acres.	Chevalier.	Spratt-Archer.	Gold-thorpe-Spratt.	Plumage Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
Ellesmere ..	826	13,849	40·60	45·30	44·90	50·40	44·60
Dunsandel ..	69	1,388	42·30	40·30	38·50	53·40	40·40
Lincoln ..	239	2,724	52·50	44·80	39·80	46·70	47·80
Totals ..	1,134	17,961	43·60	44·80	41·30	50·30	44·90
Number of fields	..	..	345	639	42	108	1,134
Acres ..	..	..	4,826	10,922	529	1,684	17,961

Table 10.—Grading of Product (No. 1 Grade).

District.	Number of Fields.	Acres.	Chevalier.	Spratt-Archer.	Gold-thorpe-Spratt.	Plumage. Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Ellesmere ..	826	13,849	62·20	62·90	56·30	67·70	63·30
Dunsandel ..	69	1,388	63·90	53·80	69·50	75·90	59·00
Lincoln ..	239	2,724	78·30	53·60	82·80	50·10	68·00
Totals ..	1,134	17,961	67·10	61·30	72·00	67·00	63·70
Number of fields	..	..	345	639	42	108	1,134
Acres ..	..	..	4,826	10,922	529	1,684	17,961

In considering the data greater attention should be taken of averages covering a large area over a period of years than those covering one year only. In judging varieties the ideal is one combining a high yield with a high grade of quality.

INCIDENCE OF DISEASE.

A period of very dry weather followed sowing until the 19th December; thereafter conditions were more favourable, but the quality of the grain was adversely affected by intermittent showers during harvest.

Following are summarized observations regarding the various fungous diseases—*Loose Smut:* None observed. *Covered Smut:* None observed in crops from seed either direct hot-water treated or once removed from hot-water treatment. A trace present in a few crops grown from seed in which was accidentally mixed a pure strain which had not been rendered smut-free. *Rust:* None in early crop and only one or two late crops affected. *Mildew:* None observed. *Stripe:* A few traces only.

II. CROP RESULTS WITH WHEAT.

In 1924, when the hot-water treatment of seed barley was first started here, a certain amount of seed wheat was similarly treated and sown on the Canterbury Seed Co.'s farms. Since then an increasing amount of seed wheat has been treated annually, and the product of this seed has been distributed among the wheat-growers.

In 1928 the certification of seed wheat was commenced by the Department of Agriculture and the Wheat Research Institute with the object of enabling farmers to secure strains true to name. During the past seven or eight years the above institutions have bred a number of pure strains, and many of these have been handed over to the Canterbury Seed Co. for multiplication and for hot-water treatment to free them from both loose and covered smuts.

After seed-wheat certification had been in operation for three years and a considerable area of wheat grown from certified seed, and hot-water-treated seed had been entered for certification, the Wheat Research Institute and the Department of Agriculture decided to grant certificates only to those crops which had been grown from hot-water-treated pure strains. Thereafter the only wheats to be certified were the product of seed which at some time previously had been through the hot-water treatment.

During the last few years the incidence of smut in wheat has diminished greatly, so that now it is a very small worry in the milling trade compared to conditions ruling ten or twelve years ago. Also the yield of wheat has steadily increased during this period. Although a portion of the increased yield may be due to more favourable seasons, the general increase is undoubtedly due to a combination of factors, the chief of which are the elimination of loose and covered smut by hot-water treatment, the production of pure strains by the Department of Agriculture and the Wheat Research Institute, the rejection of useless strains as a result of the Wheat Research Institute's work, and the certification of pure smut-free strains by the Department of Agriculture.

BLUE LUPINS IN CANTERBURY.

R. McGillivray, Fields Superintendent, Christchurch.

The value of annual lupins for green-manuring purposes has long been recognized, and the Department of Agriculture conducted lupin experiments in Canterbury as far back as 1911.

In these trials the white variety found much favour owing to the rapidity of its growth and the abundance of foliage available for turning under. In a trial at the Ashburton Experimental Farm in 1920 the white variety proved definitely superior to the blue in production per acre, but was found susceptible to serious frost injury, and for that reason was adjudged inferior to the blue variety (*Lupinus angustifolius*) for general sowing in frosty districts. All lupins are subject to frost injury in the early stages of growth, and for that reason late autumn sowing is not advisable.

In some quarters the opinion is held that lupins will grow only on sandy or light shingly soils, but this is not the case, as blue lupins make excellent growth on clay soils and the production on such soils is frequently far in excess of that of the free-soil types.

Growers of lupins who have not had previous experience of the crop have at times expressed keen disappointment in connection with the early growth of the lupins. Germination is generally good but

for a time growth is slow. When, however, the plants are fully established development is fairly rapid. It can be said that lupins take a long time to mature, but when sown with other crops such as rape and turnips this slowness of maturity is not detrimental as the rape and turnips grow quite well in co-operation with the lupins, which do not appear to reduce the yield of rape or turnips. There is, however, considerable difference of opinion on the point as to whether the growth of lupins in any way increases the yield of turnips or rape. The general opinion is that no great increase takes place, but one can state definitely that there does not appear to be any reduction in yield due to the dense growth of the lupins.

When sown with a pasture-mixture there is apparently considerable benefit accruing to the grasses from the lupins, as establishment, in spite of considerable shading, is good, and the grasses are of a good colour. This has been noticed even in the case of volunteer grasses growing with rape and turnip crops in which lupins have been included. The grass plants under such circumstances, even in the case of sweet vernal and dryland brown top, show a dark green, vigorous, and healthy growth. Under dry climatic conditions and in light land the inclusion of lupins when laying down a pasture has distinct possibilities.

For some years past inquiries have been coming to hand from farmers in various districts in connection with the growing of blue annual lupins for both green manuring and fodder purposes. The opinions of farmers who have grown lupins for feed purposes are extremely diverse. Some are quite satisfied with their results, while others state that none of their animals will eat the lupins. In making inquiries as to the time of feeding, farmers' views again are found to be most conflicting. Some state that they have found the greatest benefit from feeding when the growth is 4 in.; others feed when about 12 in. of growth is showing, while others again favour feeding at the flowering stage, and a number state that no feeding should take place until the pods are nearing maturity. This probably is the best time to feed.

The concensus of opinion is that at first sheep do not take kindly to lupins and eat all other feed present in the field before the lupins are dealt with. A number of farmers have reported a death-rate among their sheep and lambs through lupin-feeding, but hardly two opinions are identical as to the time that the lupins are most toxic. The symptoms of trouble seem to be trembling and a staggering gait and the trouble is greatest amongst breeding-ewes. One grower of lupins reported that he found it necessary to use great care in shifting his sheep after they had been grazing on a lupin area for a fortnight or three weeks as he found they were liable to have staggers, but he stated that he considered they could be cured by being placed on grass.

In sowing rape and lupins the seeding is approximately one bushel of lupins and 2½ lb. of rape per acre, sown through alternate coulters with a resultant crop of a drill of rape and a drill of lupins alternately throughout the field. If sown with turnips the seeding is from 8 oz. to 10 oz. turnips and from a quarter to half bushel of lupins per acre sown through alternate coulters. The oat mixture is one bushel oats and from one and a half to two bushels of lupins per acre, the seed

being mixed and sown through every coulter. For best results in germination lupins should be sown at a depth as shallow as possible.

Some farmers sow lupins without fertilizers; others use superphosphate at the rate of 1 cwt. per acre, while others favour the lime-super. mixture applied at various rates, according to the view of the various farmers.

In some cases where cereals follow a lupin crop that has matured there is a considerable volunteer growth of lupins in the cereal crop and in one district a farmer has found that the lupin seed scattered by north-west winds has secured a hold on his tussock country and under these circumstances may become a weed.

In conclusion, one can summarize the position as follows: For green-manuring purposes lupins are an excellent crop to grow. For seed-production they have generally proved a profitable crop but are somewhat difficult to harvest. Under conditions of good rainfall it is doubtful if lupin-culture is worth much consideration from a grazing point of view. Under the dry climatic conditions prevailing in Canterbury they have a value for grazing, especially in combination with other crops, and it is proposed later on to give actual particulars of results obtained by farmers who have been growing lupins for various purposes.

SEED TREATMENTS FOR WHEAT, BARLEY, AND OATS.

J. O. C. NEILL, Field Mycologist, Plant Research Station, Palmerston North.

ANY cereal-grower who omits to treat his seed for the prevention of smut diseases is running a foolish and unnecessary risk. The expense and trouble of doing so is a very small premium to pay for insurance against an otherwise almost certain loss in quantity and quality of the crop.

Until comparatively recent years wet "pickles" were used for this purpose, usually solutions of bluestone or formalin. These "pickles," while holding the smuts in check fairly well, were troublesome to carry out, and frequently led to more or less severe injury to germination and early growth of the crop. The modern tendency in all countries is to substitute for them treatment of the seed by various chemicals in dust form. The chief advantages of the dusts are their greater reliability in smut control combined with complete elimination of the risk of seed injury, ease of application when a dusting machine is available, better run through the drill, elimination of risk of reinfection from sacks, &c., between treatment and sowing, and the fact that, since dusted seed keeps at least as well as untreated seed, treatment may be done at any convenient time between harvest and sowing. This latter fact allows of treatment following machine dressing, the grower receiving his seed dressed and dusted ready for sowing. Their chief disadvantages are greater cost for material (from 2d. to 4d. per bushel of seed depending on the dust used), the need for a special machine to do the dusting, and the fear of poisonous effects on the workmen who carry out the dusting. Taking these disadvantages in order: the cost *per bushel of seed* is

certainly much higher, but the extra cost *per acre of crop* is at the most under a shilling—a small sum compared with the possible loss from a poor strike or a smutty crop; secondly, dusting must be done thoroughly or not at all, and this involves the use of a dust-proof mixer—not a usual article of farm equipment. An efficient, if somewhat slow, home-made machine can be made for less than £2, and factory-made machines purchased for very little more. Further, most seed-cleaning works are now prepared to dust seed lines at a cost equivalent to labour and material. Reported failures of dust treatments to control smut can generally be traced to inefficient application —tumbling in a sack or shovelling on a floor for instance. For the third objection, no unpleasant effects are to be feared from the dusts provided reasonable precautions are taken to avoid breathing dust laden air.

Methods recommended in Order of Preference.

(1) organic-mercury dusts (ceresan, agrosan g., etc.).

These are applied at from 1½ oz. to 2 oz. and cost from 3½d. to 4½d. per bushel. They are excellent preventives of smut on all cereals, excepting the loose smuts of wheat and barley (which are only controlled by hot-water), and, in general, promote a quicker and more vigorous germination than that of untreated seed.

(2) copper carbonate and copper oxychloride dusts.

These are applied at 2 oz. and cost about 1½d. per bushel. They are efficient controllants of stinking or ball-smut in normal lines of seed-wheat, but are not effective with barley or oats. They have no adverse effect on germination.

(3) formalin steep and sprinkle.

For steeping wheat the solution should be made up at the rate of 1 pint of commercial formalin to 60 gallons of water; for barley and oats at 1 pint of formalin to 40 gallons of water. Cost of material about ¾d. per bushel.

Steeping Method.—The bags of seed, one-third full, should be dipped overnight for ten minutes in the formalin solution made up exactly to the recommended strength. Additional quantities added to the bath to keep up the level should be first made up to the same strength. After dipping, the bags are flattened out singly on a floor with good drainage to partially dry out. The seed will be ready to sow the next day. If facilities are available, it is better to empty the grain into a perforated container in the formalin bath and to skim off the smut balls, the seed being afterwards placed in a covered heap to drain. When left amongst the seed the smut-balls may break in the drill and reinfect the seed.

Sprinkle Method.—Using the same strength of formalin solution, thoroughly wet the seed by sprinkling through the fine rose nozzle of a watering-can while turning with a shovel on a barn floor. The solution should be used at the rate of 1 gallon to 4 bushels. After thorough mixing, the seed should be piled in a heap and covered overnight with sacks soaked in the formalin solution.

Seed disinfection with formalin is a good preventive of smut but may cause severe injury to germination if, for any reason, sowing is delayed or if the soil is dry and remains so for a few days after sowing.

(4) BLUESTONE STEEP OR SPRINKLE.

Strength of solution: 1 pound bluestone to 10 gallons of water; cost of material about $\frac{1}{6}$d. per bushel. The sprinkle method as outlined for formalin is commonly employed by farmers who still pickle with bluestone. Bluestone, though it controls smut fairly well, invariably depresses germination and early growth, and for this reason cannot be recommended.

BISULPHITES AS WEEDKILLERS.

IT was pointed out in a recent article (see "Chemistry of Weedkillers," by B. C. Aston and J. A. Bruce, page 173 of this *Journal* for March, 1934) that in the course of a search for a suitable chemical compound for killing ragwort, which would not have the inflammable and explosive properties of sodium chlorate, certain oxidizing salts might prove efficient in ragwort-control. In following up this line of investigation the above writers have to report that other salts, such as bisulphites which are non-inflammable and non-poisonous, in addition to hypochlorites, thiocyanates, and chromates, have so far given some promising results when used in fairly strong solutions and in the dry form, in preliminary ragwort extermination experiments.

The cost of bisulphites is in general much lower than the usual type of weedkilling compounds, being, for instance, very much cheaper to manufacture than sodium or calcium chlorate.

When tried out on lawns, gardens, and paths in Wellington in the dry and solution form good kills of weeds were obtained, a fact which is suggestive that they may yet prove, for example, to be more suitable for this particular domestic use than the decidedly poisonous arsenical preparations and the dangerous chlorate compounds which have been in use for some time.

The toxicity of bisulphites as weedkillers, and their effectiveness as ragwort exterminators in particular, will be learned from the conduct of further experiments under various conditions, and at a later stage it will be possible to report in this *Journal* more accurately their scope in this direction.

The manufacture of commercial bisulphite of soda is accomplished by passing sulphur dioxide gas through caustic soda solution, until saturation occurs, when crystals of bisulphite of soda are deposited.

—*B.C.A. and J.A.B.*

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 31st May to 28th June, 1934, include the following of agricultural interest:—

No. 70214: Regulating flow of milk; R. M. Marshall. No. 70814: Hinge; A. S. Irvine. No. 70853: Refrigerator; Imperial Chemical Industries, Ltd. No. 71136: Manure-distributor; J. Macalister. No. 71836: Insect-trap; J. S. Allan. No. 71924: Vat for cream; F. C. Anderson. No. 71955: Bridle; A. E. Tilburn. No. 71982: Spraying-apparatus; G. A. Hinds. No. 70476: Chicken-brooder; S. H. Bevan. No. 71616: Coupling for tractor and trailer; O. D. North, P. G. Hugh, and Scammell Lorries, Ltd. No. 71807: Seed-sower; G. W. Wakeham.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION TO 30TH JUNE, 1934.

APPENDED is a list of growers whose crops have been subject to and have passed the tuber inspection in connection with the system of Government certification of seed potatoes conducted by the Department of Agriculture. The list comprises those crops passed up to 30th June. Further lists will be published in later issues.

In the June *Journal* was published a list of growers who have received provisional certificates. The acreage, percentages of foreign varieties present, and the group number and classification representating the relative merits of lines were given in that list, to which intending purchasers should refer.

AUCKLANDER SHORT TOP.

Mother Seed—
Dyer, H., Southbrook, Rangiora.
Hegan, J., and Son, Southbrook, Rangiora.
Martin, W. E., R.M.D., Kaiapoi (Line B).
Oakley, W., R.M.D., Halkett.
Petrie, J., jun., R.M.D., Swannanoa.
Swanson, W., Selwyn.

Commercial Seed—
Berryman Bros., 88 Winter's Road, Papanui, Christchurch.
Eder, W., R.M.D., Sefton.
Porter, E., St. Andrews.
Seivwright, R. M., Meadows, Washdyke.
Weeber, H., Englefield Road, Belfast.

DAKOTA.

Mother Seed—
Johnston, R. H., Dunsandel.

ARRAN CHIEF.

Mother Seed—
Wright, L. T., Annat (Line A).

Commercial Seed—
Brown, A. F., 287 Withell's Road, Riccarton, Christchurch.

ARRAN BANNER.

Mother Seed—
Oakley, W., R.M.D., Halkett.

Commercial Seed—
Dyer, H., Southbrook, Rangiora.
Guy, T. A. and E. B., Yaldhurst.

KING EDWARD.

Mother Seed—
Brown, A. F., 287 Withell's Road, Riccarton, Christchurch.

KING EDWARD—*continued.*

Commercial Seed—
Craig, G. H., Factory Road, Mosgiel.

JERSEY BENNES.

Mother Seed—
Wilson Bros., Quarantine Island, Port Chalmers.

Commercial Seed—
Graham, J. W., Factory Road, Mosgiel.

EARLY REGENT BOLTER.

Mother Seed—
Oakley, W., R.M.D., Halkett.

Commercial Seed—
Oakley, J. T., R.M.D., Eiffelton.

EARLY ROSE.

Mother Seed—
Caldwell, G., R.M.D., Courtenay.

EPICURE.

Commercial Seed—
Campbell, D., King Street, Rangiora.

MAJESTIC.

Mother Seed—
Penn, T. A., 154 Innes Road, Christchurch.

Commercial Seed—
Oakley, J. T., R.M.D., Eiffelton.

ROBIN ADAIR.

Commercial Seed—
Wright, Q., Annat.

UP-TO-DATE.

Commercial Seed—
Guy, T. A. and E. B., Yaldhurst.

At the Nelson Research Orchard, under a shade temperature of 80° F., a tank surface of 20 ft. by 20 ft. loses approximately 40 gallons of water by evaporation per twenty-four hours. Under the influence of hot winds the rate of evaporation is even greater.

SEASONAL NOTES.

THE FARM.

Pasture Management.

MUCH benefit has resulted from top-dressing in July and August. Hence a farmer who has not already top-dressed as extensively as is warranted may at this stage carry out top-dressing with every confidence that he will secure good results. Ordinarily superphosphate should be used almost invariably at this season; field trials have shown that in many important grass-farming districts it will make its influence felt substantially in four weeks from the date of its application at this time of the year. Under certain circumstances during July and August sulphate of ammonia or analogous nitrogenous manures may be applied with profit as a means of obtaining additional late winter and early spring feed. The use of nitrogenous manures for this purpose was discussed further in last month's notes.

Harrowing of pastures is advisable widely in August, and if not carried out on fields on which animal manure is plentiful the spring pasture growth will be very uneven, on account of the development of patches of rank herbage in the vicinity of where droppings have been undisturbed for any considerable period. As it is not at all easy to deal satisfactorily with rank patches of grass-growth on farms supporting principally "wet" stock, it is desirable to obviate the appearance of such patches by timely use of the grass harrows to distribute the droppings before the bulk of their fertilizing ingredients have been washed into the soil beneath.

Top-dressing of sod-bound and weedy pastures is almost certain to prove much more effective when accompanied by relatively severe harrowing. The harrowing should be severe enough to open up the turf and thereby give a chance to plants of better species, the greater growth of which is made possible by the increased fertility, to develop more vigorously. This brings about the pasture-rejuvenation which is so advisable on many old-established permanent pastures that cannot be renewed economically by putting the land under the plough.

A most important matter that many farmers will need to consider at this season is the amount and location of the grassland it is advisable to put under the plough during the next few months. In this matter a prime consideration is the adequate provision through the use of such crops as mangels, swedes, turnips, chou moellier, lucerne, and carrots of feed for the critical periods when the feed available directly from grassland is customarily below the current requirements of stock. Secondly, the ploughing-down of many pastures is called for because of their inferior swards; often, for instance, pastures which are dominantly weeds, brown-top, or dogstail may be found occupying ground which could profitably support swards rich in rye-grass, cocksfoot, and white clover, and this especially if given reasonable assistance in the form of phosphatic top-dressing and efficient grazing management.

With past experiences in mind farmers at times hesitate to plough up pastures which they realize are not of as high a standard as could reasonably be expected in the circumstances: they doubt whether they will be able to replace the pastures which they consider relatively poor by ones which will remain superior long enough to make the undertaking a profitable one. The doubt originates almost invariably in the past use of inferior strains of pasture species which were associated with a rapid falling-off in the production of relatively young pastures and

to-day is unjustified because of the availability, through official seed-certification, of strains of seed the use of which will not lead to the disappointing results which at times occurred in the past. After making due allowance for the considerable improvement of swards that can be effected in some cases by judicious top-dressing, it may still be said that generally the most advisable method of obtaining an improved sward is by ploughing and eventual reseeding. In some instances this method, because of labour-cost or other considerations, may not be practicable, and it may be advisable to attempt to bring about sward renovation by surface-sowing of seed. It should be remembered that surface-sowing of seed is associated with risks, arising mainly from weather conditions, and is not always successful. Hence, if practicable, the sowing of seeds on a cultivated seed-bed should be followed.

Young pastures, and particularly those it is intended to make permanent, should be treated with special care during winter and early spring. The two extremes, undergrazing and overgrazing, equally should be avoided. Undergrazing is likely to occur in winter and early spring only when stock are being kept off young pastures specially to avoid "poaching" or "pugging" of the soil. It leads to the suppression or weakening of valuable pasture species such as clovers and crested dogstail, and is likely to be particularly harmful in a young pasture which contains a large proportion of Italian rye-grass—a species which should not be allowed to become long in young pastures. To avoid both under-grazing and as much poaching as practicable, sufficient stocking should be carried out, and that as far as possible only when the land is dry.

Overgrazing which readily leads to a setback to valuable species before they have properly established themselves is much more likely than undergrazing to occur in August. Overgrazing in the spring is also likely to be markedly harmful to old-established swards, especially when it is associated with undergrazing in the summer and autumn as it often is. Perennial rye-grass is especially susceptible to weakening by overgrazing in the early spring. How injudicious grazing manage-ment may influence the composition of permanent pastures was illus-trated in a recent report of an English investigation carried out by M. G. Jones. A pasture which continually had been overgrazed in the spring and undergrazed in the summer and autumn contained approxi-mately 2 per cent. perennial rye-grass, 6 per cent. of white clover, and a total of 91 per cent. of useless plants, while another portion of the same pasture after only two seasons' rational grazing and identical top-dressing contained approximately 21 per cent. perennial rye-grass, 20 per cent. white clover, and a total of 52 per cent. of useless plants—still a poor sward, but nevertheless substantially improved solely by better grazing management in which overgrazing in the spring was avoided. The grazing in the spring by sheep of young pastures when not overdone is valuable because of the even, thorough con-solidation of the soil which it brings about; but too-close grazing, if not guarded against, readily takes place.

Crops for Pig Feeding.

The substantial increase in pig-keeping which is expected warrants greater attention to the raising of crops suitable for feeding to pigs. There is considerable recent field experience indicating that the feeding of such crops as mangels, swedes, and chou moellier in considerable quantities in winter and early spring to pigs is giving attractive returns. Of these, the mangel is especially important both because of its high potential yield of nutriment an acre and of the fairly common belief that the mangel in some obscure way is unsuitable for pigs. Fully matured mangels have been fed widely as a substantial portion of pigs' rations with thoroughly

good results. Detailed information may be obtained on application. However, the feeding of mangels as the sole constituent of pigs' diet is not recommended, as similarly a diet of several other feeds alone, such as swedes, is not recommended, even though the safety of these crops when fed judiciously is never questioned. It is preferable that the giving of a place to mangels and similar roots in the pigs' rations be effected gradually.

In the North Island good returns have been obtained in recent seasons from feeding to pigs barley and field peas grown on the farms on which they are used. Though the experience in this respect is limited, it is extensive and conclusive enough to indicate that the growing of these crops for pigs would prove profitable at the current prices for pig-flesh over wide areas in the North Island in which little cropping is done. In some instances in which outstanding results were obtained no implements additional to those ordinarily on dairy-farms were employed—the crops were cut with the mower and all threshing was was done by the pigs. In the warmer districts it might be advisable to grow maize instead of barley.

General Cropping Work.

The ploughing of land intended for cereals should now receive attention ahead of almost all other tillage work. From experience it has become the practice to sow the greater part of the spring wheat crop in August and early September. In some districts good crops may be obtained from later sowings, but as a rule in the main grain-growing districts the yields are not so heavy from such sowings. The sowing of oats ordinarily should follow the sowing of wheat as opportunity offers. It often proves advantageous to sow black skinless barley in August. A heavier amount of seed should be used with spring-sown cereal crops—*e.g.*, in the main South Island wheat-growing districts, while 1½ bushels to 1¾ bushels of Tuscan seed is accepted as suitable for autumn sowing, two bushels or more are used for spring sowing. Spring-sown cereals generally benefit from the rolling of the ground after sowing, but, except in the case of light land, the rolling, instead of being done immediately after the drilling, should be deferred until September or October.

Treatment of cereal seed for the control of disease should not be omitted in spring sowings. It seems at times to be overlooked that smut is decidedly detrimental in an oat crop which is to be chaffed, and also that the Algerian oat is subject to smut, and hence that there is just as much need to treat seed of Algerian as seed of the other varieties. The methods of treatment are discussed in the article commencing on page 43 of this *Journal*.

When it is intended to produce chaff or grain from autumn-sown cereals, the final feeding-off should take place generally towards the end of August—an exception to this being crops on such rich ground that "lodging" may be expected. It is often of assistance in avoiding "lodging" to arrange the final feeding-off of such crops to take place in September. Ordinarily after the final feeding-off the crop benefits from a stroke or two of the tine harrows for the purpose of loosening the trampled surface soil and of scattering stock droppings. Spring feeding-off of cereals should be done by stocking heavily for a short period at a time when the ground is not too wet.

Italian rye-grass or Western Wolths, which often can be sown successfully at the end of August, may be looked upon as a special forage crop capable of providing hay or silage if necessary. Artichokes, which may be sown from late August or September, according

to the earliness of the locality, thrive on land naturally suited to potatoes, but they will also yield well on comparatively poor, light soils, provided they are well manured. The crop succeeds when the seed is sown in rows about 3 ft. apart with about 2 ft. between the tubers in the rows; 8 cwt. to 10 cwt. of seed an acre is required. Generally, a complete mixture is favoured for artichokes. The ground for artichokes requires to be well worked before the sowing of the crop.

If possible grazing of established lucerne during winter and early spring in particular should be avoided. Grazing by causing consolidation favours the invasion of the lucerne by rye-grass and *Poa annua*, two of its worst and most common invaders over wide areas. Further, grazing keeps the growth short, which favours white clover, at times a serious weed in lucerne areas. Harrowing of established weedy lucerne occasionally may be advisable at this season, but generally it is inadvisable unless the conditions allow one to lessen substantially the number or vigour of the invading weeds without unduly injuring the lucerne itself. Especially in the main grass-farming districts, the only harrowing that as a rule gives this result is one carried out about January or February, when the dry conditions and the rapidity in growth of the lucerne combine to suppress weeds disturbed by cultivation. Some cultivate lucerne as a routine measure and without due thought, and often do as much harm as good or even more—any cultivation drastic enough to thin the weeds is practically certain also to thin the lucerne. Lucerne which is heavily invaded by grass should be top-dressed, not in the early spring while it is still somewhat dormant, but later on, perhaps after the first cut, when it can outgrow the grass. To top-dress in the early spring would lead to relatively greater stimulation of the grass, which would intensify its smothering effect—just what should be avoided.

Miscellaneous.

The late July–August period is a critical one in the feeding of stock. While it may be economically sound at times to allow store cattle and sheep to fall off in condition, at this period it is often a costly matter to allow milking-cows and breeding-ewes to do so. In both these types of stock production is likely to be lessened, and, in addition, ravages of disease often originate from weakened vitality which arises at this stage. Yet farmers with stock unduly low in condition at this period at times carry over reserves of feed; they would probably be wiser to use such feeds as it is required and allow the future to take care of itself.

During wet weather time may often be spent profitably in overhauling equipment in preparation for the busy season, and in the picking-over of stored potatoes. In dry weather matters to which attention often may well be given are improved farm-subdivision and the construction of pits or trenches for ensilage.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Control of Pests and Diseases.

GENERALLY, weather conditions during the past two months have been favourable for the carrying-out of the late autumn and early winter orchard operations, therefore it is presumed that the majority of orchardists already will have carried out at least the principal work as outlined in these notes for the months of May and June—*i.e.*, after-harvest-clean-up, cultivation and manuring, and pruning. The spray outfit must of necessity play an important part in orchard practice from now on until next autumn. Therefore growers who have not already done so are urged to lose no time in the

overhaul of this important orchard unit to ensure that it is in thoroughly good order for the work ahead. The hose also should be tested, and, if at all weak, should be replaced with new equipment. The dormant or winter spray for control of sucking insects such as mussel scale, San Jose scale, red-mite, woolly aphis, mealy bug, &c., on pome and stone fruit trees should be applied as early as possible after pruning, as there is nothing to be gained by delaying this spray application until a week or two prior to bud movement. Winter-spraying oil is recommended for this purpose, and should be applied during the dormant period at a 10-per-cent. concentration. Assuming that all oils are of 100 per cent. concentration the quantity of oil required is 10 gallons to 90 gallons of water. If the oil content is less than this concentration, adjustment in the dilution must be made accordingly.

To ensure a perfect emulsion soft water must be used for mixing. Hard water may be softened by the addition of washing-soda at the rate of 1 lb. per 100 gallons water. Extremely hard water will probably require the addition of a little extra washing-soda to ensure a satisfactory emulsion being obtained. The required quantity of spraying oil (say, 10 gallons) should be measured into a clean mixing container, and the same quantity of water (10 gallons) poured slowly into the oil, stirring thoroughly while the water is being added. The result, provided the necessary details are attended to, will be a milk-like solution, with no free oil in evidence. The balance of the water (80 gallons) may then be added slowly while the mixture is kept well stirred. This is a contact spray, and kills by asphyxiation the pest for which it is applied. When applying the spray the operator must be thorough, as all pests or their eggs not covered by the solution will survive and subsequently increase in numbers. Furthermore, the spray must be applied with sufficient force to drive it into all corners, crevices, and under loose bark, for it is in such places that many of the pests and their eggs, or both, are to be found during the dormant season. The spores of fungous diseases overwinter on laterals, branches, spurs, and fallen leaves and fruits. The control of important diseases of stone and pome fruits is therefore partly dependent upon the elimination of the sources of infection—*i.e.*, the removal and burning of all dead and diseased twigs and branches and the deep ploughing or digging under of fallen apple-leaves prior to blossoming, as well as the gathering and destruction of all mummified fruits on stone-fruit trees. Where practicable mummified fruits on apples and pears should also be removed. This treatment must be followed up by spraying, which should be delayed until the "bud movement" of blossom buds on stone fruits, and the "green tip" stage of buds on pome fruits, when each kind in turn should be sprayed thoroughly with bordeaux mixture 5–4–50. Much depends upon this basal spray covering in so far as the control of subsequent fungus infection is concerned. Growers are advised to take every care when making and applying bordeaux mixture to see that only the very best of materials are used, and that the application of the spray is very thorough. The following method of preparing bordeaux mixture is taken from Bulletin No. 161, "Control of Orchard Diseases and Pests by Spraying":—

"Fill the spray-tank three parts full with water; dissolve the required quantity of copper sulphate in water (3 lb. or 5 lb. for each 50 gallons of water), add to the tank and start the agitator running. The copper sulphate may be dissolved with rapidity if hot water is used (5 lb. will go into solution in a minute or so in 1 gallon of boiling water), or, if first powdered, may be added directly to the spray-tank. Alternatively, it may be placed upon the strainer covering the intake, so that the incoming stream of water carries the particles into the tank, in which case it will go into solution within two minutes. When the dissolved copper sulphate has been added, weigh out the required quantity of commercial hydrated lime (4 lb. for each

50 gallons of water), mix to a thin paste with cold water, and with the agitator still running pour slowly into the tank, at the same time filling the tank to its capacity. Keep the agitator running for a further few minutes and the spray is then ready for application.

"The hydrated lime must be of good quality, containing not less than 90 per cent. of $Ca(OH)_2$; if the content is less than this, adjustment must be made accordingly."

—J. W. Whelan, Orchard Instructor, Palmerston North.

Citrus Notes.

At this period of the year, when the gathering and marketing of the Kawau Orange (Poorman) is being undertaken, it is very important for growers to realize the double purpose for which this fruit is used. It is of great value as a marmalade orange, and is also used extensively for juice purposes. However, it is well to remember that the seasons for picking for the different uses are not identical, and unless the fruit is harvested at the appropriate time according to the use to which the fruit is to be put the greatest value will not be obtained.

The best season for marmalade purposes is during the months of June and July, or, in other words, just when the outer skin of the fruit is commencing to turn from the green to the yellow. During this period when made into marmalade it jells more freely than if used later in the season. If used for juice purposes in this early stage it does not impart the satisfaction that it does when picked for the purpose at a later stage. There is every indication of this fruit coming into great favour, and the consumption will increase rapidly as the years advance, providing growers realize the definite distinction between the season for marmalade and that in which it should be used for juice purposes. Not only does the quality of the juice increase by the fruit remaining on the tree for a while longer, but the quantity also increases. It can be assumed safely that in the very near future this orange-drink will become one of the most popular thirst-quenching and appetizing juices. Hence growers are urged to keep in mind the great necessity of educating themselves and also the buyers along the lines indicated, in order to stimulate greater consumption.

Every provision already should have been made for new plantations, and if this has not been done it would be much better to delay the planting for a season.

Good shelter, thorough conditioning of the land, and adequate drainage are of the first importance. If the land is not of a porous nature, so as to permit the surplus water to drain freely away, underdrainage must be provided. Tile drains of suitable dimensions according to the length of drain are the most satisfactory. Drains of logs and brushwood, although useful under certain conditions, are not altogether suitable or satisfactory except for a short period.

Where everything is in readiness for planting and the soil is in a suitable condition the trees could be planted now. However, if the soil is wet, it would be better to defer planting until later, as it is not good orchard-practice to plant out trees where the soil is wet and cold.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Time to Hatch.

August and September are recognized as being the best months of the year for hatching out chickens for the renewal of stock. It should therefore be the aim of all poultry-keepers to secure the required number of young birds before the end of September. If chickens are to develop into really profitable stock, it is imperative that they be well over the brooder

stage before the hot summer weather sets in. The production of late-hatched stock is the weak link on many unsuccessful plants. There are no chickens that do so well as those which develop as the days are lengthening rather than when they are on the wane.

Inbreeding.

Several inquiries have reached me of late in regard to mating stock. In some cases the inquirers have suggested close inbreeding, and are desirous of knowing whether the pullets produced from such matings would possess heavy egg-yielding power. Such inquiries cannot be answered with any degree of satisfaction. It is true that no great advance has ever been made in the improvement of type in domestic stock without inbreeding of the selected foundation animals, but there are serious dangers attaching to this method of fixing type, especially if the inbreeding is followed out without any definite method or aim. The danger is particularly great with poultry. It is a simple matter to advocate inbreeding or to talk about it, but to advise others how to carry it out successfully is an entirely different matter. Indeed, to advise poultry-keepers generally how to inbreed, when to inbreed, and when not to inbreed, as a means of promoting or maintaining heavy egg-production without being familiar with the stock and their surrounding conditions is an absolute impossibility.

In the first place, it is necessary to study the bird to be bred from, whether it be a cock or a hen. The birds must conform to desired shape, and some definite knowledge must be possessed of pedigree and egg performance, together with the relationship of the birds to be mated, in order to have some guarantee that the type aimed at will be secured. Unless exact principles are adhered to, inbreeding will probably bring about a deterioration in the stock which will prove disastrous. Many troubles are being experienced to-day in the way of weedy stock, disease, parasitic infestation, and the production of small eggs, as a result of inbreeding; not so much from the inbreeding deliberately done with stock of which the true history is known, but from that regrettable inbreeding arising from a want of knowledge of the stock being handled. Quite often this ignorance regarding the breeding birds is not the fault of the breeder, but is the result of some specialist breeders who designedly or unknowingly do not possess an accurate knowledge of the strains with which they are working or sending out for breeding purposes. During my experience I have often received requests for cockerels of a certain breed to mate with hens of say Mr. B.'s strain, and as Mr. B. had only Government stock the inquirer is practically asking in all innocence for a related bird. We cannot know too much about the pedigree of the birds we desire to breed from. Unfortunately the life of the domestic fowl is too short to warrant the compilation of stud-books that would serve a generally useful purpose, and the purchaser must necessarily depend on the breeder's word as to the bird's breeding. This naturally tends to loose breeding methods, which render it a most difficult matter to place poultry-breeding on that sound foundation so essential to the best results. As previously indicated, judicious inbreeding is one of the chief secrets of success in advancing type, but it is likely to prove a pitfall to the inexperienced, and even to the keen enthusiast it is fraught with danger in the absence of the exact knowledge necessary to its successful application. To the breeder who is aiming at an ideal type, and who has a keen eye for selecting form with special breeding power, and has suitable environment for rearing his stock, together with the ability to rear and manage poultry on sound lines, close inbreeding may be resorted to as a means of improving or maintaining desired qualities in a strain—whether it be in respect to egg-production or to maintaining breed characteristics. On the other hand, to the man who does not possess these qualifications or the conditions referred to inbreeding will,

in all probability, have the effect of weakening a strain rather than advancing it. It will thus be seen that, in regard to this matter, there is no theoretical course which can be recommended to suit all cases and conditions alike. The chief aim where inbreeding is resorted to is to intensify, if possible, desirable characteristics, but it must be remembered that any undesirable characteristics as well as the good ones are intensified; so that where stock are not of a high standard as regards the object aimed at, of what avail is it to continue close inbreeding?

For example, say a strain gave evidence of being on the down grade in size and constitutional vigour, then to inbreed would in all probability mean that the subsequent generations would become smaller and weaker as time went on. In such cases, rather than inbreed the aim should be to introduce fresh blood possessing strong points where the others are weak. In other words, mate with a view to improving existing good qualities, or, on the other hand, for the elimination of bad ones. When introducing fresh blood it would be advisable to first try it out with a small number of birds, or, better still, with an individual bird in order to prove whether the union gave a desired result. Very often, even when two good strains of the same breed are mated, the one may not "nick" with the other and may thus produce a full crop of disappointments by way of latent undesirable characteristics. Like does not always produce like, and, whatever system of breeding in resorted to, the law of variation will at times upset the best breeders.

In mating birds some men are specially gifted with an eye for form, and are thus able to a great extent to select prepotent specimens, that is o say, those birds which will stamp qualities possessed by themselves on their progeny. Such men are born breeders, not made; and so long as they know the family history of the strain they are working with they may possibly inbreed from generation to generation over a long period of years and still hold the desired qualities aimed at in the particular strain. In regard to inbreeding, especially when practised by the novice, the risk of losing size and constitutional vigour is the chief danger; and probably there is no other class of live-stock where constitution is of such importance as it is in the case of the modern type of high-laying fowl, in view of the fact that the reproductive organs are put to such a severe test in producing its artificially forced egg-yield. Of course constitution is not everything, but without constitution it is useless attempting to develop or maintain a desired type. It is one thing to attain an ideal but quite another thing to maintain it. For example, it would be a mistake to select a bird solely on constitutional points. These must be accompanied by the characteristics it is desired to develop. In advancing egg-yielding capacity, however, the hens which attract the male most forcibly are invariably the best breeders, and therefore, if a laying strain, will be the heaviest layers. It is a good plan to note the hens the rooster prefers, an indication of which is often afforded by the condition of the feathers on the back of the hens. If these are cut about it proves that the bird is one specially selected by the male, and a demonstration is thus provided of the best guide to breeding power—nature's selection. Nature, after all, is the best guide we have. Inbreeding apparently does not trouble rabbits and sparrows. Nature provides for the elimination of the unfit. Constitution is maintained without the necessity of imparting fresh blood, and not withstanding natural enemies—poisons, &c., and with no assistance from man—these pests multiply with amazing rapidity.

Referring again to inbreeding, and particularly in- and in-breeding, the writer cannot recommend it so far as the average poultry is concerned. To sum up, it is really like a two-edged sword, which cuts both ways. In the hands of the right man and one who may be termed a breeder, then it is all right; but, on the other hand, when practised by the wrong man it

may easily mean the ruination of a strain. In the production of heavy-laying stock the selection and mating are merely links in the chain of management. The feeding, the housing, the rearing, and the general environment of the stock are essential factors if the desired ends are to be reached.

The Moulting Birds.

A correspondent whose adult hens have not laid for many weeks past asks whether it would not pay better to cull out the birds rather than to continue feeding them for nothing. Although these fowls have been earning nothing during the past few months, he and other poultry-keepers in a similar position are advised not to resort to drastic culling at this time of year. This work should have been done in the autumn. The natural laying-season for bird-life is approaching, however, when even the sparrows will be laying, and it will be a very inferior fowl that will not pay her way before the next moult comes on. Of course, the better the feeding and general amanagement a bird receives the earlier she will come into profit.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Winter Conditions.

As indicated last month, there is little a beekeeper can do for the welfare of his bees at this period beyond examining the hives for leaky covers and damp mats, which if found should be replaced. All manipulations of the bees should cease, and the bees, having been made as snug as possible, left until the arrival of the warm spring days.

Locating an Apiary.

As the supply of grass and clover regulates the amount of stock carried on a given area, so does the same condition apply to what might be termed the grazing of bees. Unrestrained and at liberty, the bees fly where their desire prompts them, even to a distance of three or four miles from their home; but this is not necessary if a suitable site has been chosen. Rich land where clover grows abundantly and little cultivation is done is more suitable for beekeeping than any other kind; and land of this description may be found in any dairying or bullock-fattening district. Sheep-grazing land is usually eaten too bare, yet occasionally I have heard of good flows of nectar from valleys in such areas. Plenty of willows scattered over good country add materially to the value of a district in supplying early spring bee-feed; while a patch of native bush close by would also be advantageous in this respect. Catsear is also valuable as a nectar-producing plant, the honey being of an amber colour, smooth-grained, and of good flavour. After clover has finished blooming, thistles, if in any quantity, may be expected to furnish an excellent honey of a white colour, and this, blended with clover and catsear, forms a very fine product, and always commands the highest price.

Shelter.

Next to selecting a good locality, arranging for good shelter is the most important matter. The formation of the neighbouring ground would perhaps assist in this respect. If there is any choice, select a low, well-drained spot, which will enable the bees to fly down when loaded for home. Such a position will also lend itself more readily to being sheltered. It is preferable to make use of natural shelter, if

handy, providing the trees are not too large to cause a draught; where there is open country I would advise putting up a temporary fence of boards or brushwood on the sides of the prevailing winds until a substantial green fence has grown. Tagastaste (*Cytisus proliferus*), sometimes called "tree-lucerne," grows very rapidly, and makes a good shelter in two seasons. It should be planted about 2 ft. 6 in. apart, and the ground round the roots kept free from weeds. It stands a great amount of cutting, and flowers along the branches very early in spring, thus forming a very welcome addition to other early honey-producing plants.

Bees should not be placed too closely under big trees or immediately under hedges, or in any damp place, for under these conditions they become irritable, and the combs are liable to get mouldy. Bees require shelter, but at the same time plenty of sunlight.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

THERE is appreciable growth of hardy crops during the month of August in most parts of the country—it is literally springtime. Established crops of asparagus which received generous manurial treatment in summer after cutting, or during the winter, will now receive benefit from a dressing of nitrate of soda or other form of nitrogen applied at monthly intervals during the cutting-season. On light land a dressing of sulphate of potash in addition to the nitrate should be applied to a limited area to test its effect. The cabbage crop for early spring cutting may also be forced by similar manurial treatment: the potash will balance the effect of the rather generous use of nitrates, especially by preserving the colour. Early lettuce may be given a similar attention.

New plantations of asparagus may now be made, but a "rush job" should be carefully avoided. Planting must not be done unless the preparation of the land is complete—that is, mainly, it is clean, rich, and deeply cultivated and good, graded roots are available for planting. It is well to crop the land with potatoes or other annual crop for another season if there is any doubt about it being ready for planting the asparagus. Where planting is to be done twelve months hence, sow the seeds now in order that the crop may have a long season of growth and sturdy one-year-old roots will be available for planting out next year. Meanwhile select the land for planting, and let all the operations upon it during the ensuing twelve months have this end in view.

Early peas, broad beans, radish, white turnips, short-horn carrots, globe beet, and parsnips, main-crop onions, lettuce, round-leaved spinach, and parsley, as well as seed-beds of cabbage and cauliflower, should now be sown. In dry districts where summer cabbage is difficult, silver beet and New Zealand spinach are excellent substitutes and may be sown now, the former outside and the latter under glass (or outside in October). Preparation of the land includes broadcasting any necessary fertilizers and cultivating them in a week or two before sowing the crop. This cultivation should be shallow to avoid bringing to the surface more weed seeds.

Parsnips should be lifted and stored in a cool place before the flavour is spoiled by the roots making fresh growth. Celery will also require a similar attention. Where leaf-spot has been troublesome all waste should be destroyed carefully to avoid infection.

Making a Hotbed.

In a sheltered, sunny, well-drained position it is not difficult to make up a hotbed for raising half-hardy plants for setting out in the open early in the month of November. Tomatoes, egg plants, chillies, melons, cucumbers, marrows, and celery are amongst the many kinds of crops that may often be sown with advantage in boxes towards the end of August, and started on a hotbed. The heat for the purpose is usually obtained from fresh strawy stable manure that has been treated to bring about a general state of fermentation throughout the whole mass. This is done by stacking the material in a compact manner under cover; in a few days when fermentation is well established it should be turned, shaken out, and again restacked, damping-down any dry material meanwhile. By repeating this treatment two or three times fermentation becomes general. The bed is then made by spreading the material evenly and treading it firmly—building a neat solid stack of the desired height and area. The frame may then be placed in position, and in a few days, when the heat has steadied, after the bed has been thoroughly watered and the glass sashes placed in position, it is ready for use. In northern districts very little material is necessary to maintain a bottom heat of about 60° to 70° F., which is desirable. In colder localities more material will be required to maintain this temperature during cold weather; but assistance can be given on frosty nights by covering the glass sashes with mats. Where stable manure is scarce, the supply may be supplemented with leaves gathered in the autumn, where they are available.

It is a mistake to grow the plants just mentioned in an over-rich compost. The aim should be to grow hardy plants—a soil composed of good fresh loam, with a small amount of decayed manure or leaf-mould to provide humus and sharp sand to lighten the material, if necessary, is all that is required.

The preparation of the land for planting out these crops should proceed while the young plants are being grown. Turning under a green crop and working in a dressing of fertilizers, with occasional shallow cultivation to destroy weeds, are usually the main features of this preparation.

Small Fruit Crops.

A crop of Chinese gooseberry (*Actinidia chinensis*) seen recently had made an unwieldly mass of tangled growth, with a heavy crop of fruit on spurs, and young wood of moderate size. Plants may be set out now in localities that are fair to warm, and in a rich, moist soil. They require a trellis or pergola to accommodate them, and leading growth must be controlled. The plants are diœcious—that is, there are separate male and female plants—so consideration must be given to pollination. Although not showy, it is a handsome plant; the fruit, ripening late, comes in at a useful time when variety is somewhat lacking. The fruit also has quite good carrying and keeping qualities.

The white sapote from Mexico (*Casimiroa edulis*) is another new fruiting-plant that has been introduced. It is a strong-growing evergreen tree with large divided leaves. The fruit has a tender yellow skin and soft cream flesh of a delicate flavour without acidity; it ripens during the autumn. The tree is said to be very prolific, and individual fruits sometimes measure 3½ in. in diameter; it should be

planted only in a soil and climate suited for lemon-growing. It has distinct possibilities in the home garden and for local marketing, but its carrying qualities are rather doubtful.

Ground should be prepared for planting out passion-fruit and tree tomatoes (*Cyphomandra betacea*) during the months of September and October. Seeds of passion-fruit may be sown in the row where they are to grow, or in boxes and grown on for planting out twelve months later.

Gooseberries, currants, raspberries, loganberries, &c., should now be planted out as soon as possible. Where planting is to be done twelve months hence, commence the preparation of the land now. Grass land or weedy ground will take the greater part of that time to break in satisfactorily: success chiefly depends on doing this well.

Most plants of this class are affected by "leaf-spots" of different kinds, due to the attack of fungous organisms; many of these seriously affect the health and cropping capacity of the hosts, and should be prevented by timely applications of a fungicide spray. As the initial and most dangerous attack takes place in early spring, a thorough application of bordeaux 4–4–50 should be made shortly before growth commences, and repeated at intervals of about three weeks, as may be necessary, with a somewhat weaker mixture. Where leaf-roller or other chewing larvæ are troublesome, arsenate of lead may be added to the bordeaux at the rate of 2 oz. of paste or 1 oz. of powder to 4 gallons of spray. The lead should be placed in a small basin and worked up to a cream with a small quantity of water before diluting it further.

The Homestead Garden.

The present time is most suitable for planting most kinds of trees, shrubs, and other perennial plants, and this should be done as soon as the preparation of the land is completed and the soil is sufficiently dry. In dry districts especially, late planting is attended with considerable risks, which may be avoided by planting before the end of August. The same precaution should be taken in sowing down lawns, as unless the grasses are well established before the arrival of dry weather the competition of weeds is likely to be a serious matter. A good dressing of fertilizers hoed in some time before sowing will help in the quick establishment of the grasses.

It is well to sow now sweet peas and other hardy annuals outside, and half-hardy annuals under glass for planting out in November, and also to finish pruning roses, except in the colder localities, where it is better deferred until early in the month of September.

On new sections shelter-belts, hedges, drainage, and roads and paths for access are most urgent and should receive first attention. They are the important features in any layout, and should be given a great deal of consideration. Very few crops are grown satisfactorily without ample shelter and good drainage, and because of the permanent character of these improvements they should be well carried out: by extending the shelter-planting with acacias and gum-trees a good supply of firewood and useful timber may also be obtained. If roads and paths are well cambered with culverts at necessary points to get rid of the water they will give good economical service. Most important is it that these features should be well graded at the right level; they will then give better service and a very much improved appearance to the property.

—W. C. Hyde, Horticulturist, Wellington.

LICENSED MEAT-EXPORT WORKS IN NEW ZEALAND, SEASON 1934-35.

Name and Address of Licensee.	Name and/or Location of Works.	Beef-killing Capacity per Day.	Sheep-killing Capacity per Day.	Storage Capacity in 60 lb. Carcasses Mutton.
North Auckland and Auckland.				
Auckland Farmers' Freezing Co., Ltd., Auckland ..	Moerewa ..	200	4,000	165,000
" " " ..	Southdown ..	150	5,000	190,000
" " " ..	Horotiu ..	200	4,000	310,000
Westfield Freezing Co., Ltd., Auckland	Westfield ..	250	5,000	264,000
R. and W. Hellaby, Ltd., Auckand	" ..	200	2,000	100,000
Gisborne.				
Gisborne Refrigerating Co., Ltd., Gisborne	Kaiti ..	175	7,000	200,000
Gisborne Sheep-farmers' Frozen Meat and Mercantile Co., Ltd.	Tokomaru Bay	60	3,000	130,000
Hawke's Bay.				
Nelson's (N.Z.), Ltd., Tomoana	Tomoana ..	150	7,000	150,000
Hawke's Bay Farmers' Meat Co., Ltd., Hastings ..	Whakatu ..	100	8,000	180,000
Wairoa Farmers' Co-operative Meat Co., Ltd., Wairoa ..	Wairoa*	100	3,000	70,000
Taranaki.				
Thomas Borthwick and Sons (Aus.), Ltd., Masterton ..	Waitara ..	350	4,500	80,000
J. C. Hutton (N.Z.), Ltd., Wellington	Eltham ..	60	..	25,000
Patea Farmers' Co-operative Freezing Co., Ltd., Patea ..	Patea ..	150	3,800	180,000
Wellington.				
New Zealand Refrigerating Co., Ltd., Christchurch ..	Imlay ..	200	7,600	203,000
Thomas Borthwick and Sons (Aus.), Ltd., Masterton ..	Feilding ..	100	3,500	96,000
National Mortgage and Agency Co. of New Zealand, Ltd. (Head Office, Dunedin)	Longburn ..	80	4,000	80,000
Thomas Borthwick and Sons (Aus.), Ltd., Masterton ..	Waingawa ..	300	7,000	125,000
Gear Meat Preserving and Freezing Co. of New Zealand, Ltd., Wellington	Petone ..	100	10,000	300,000
J. C. Hutton (N.Z.), Ltd., Wellington	Ngahauranga ..	120	3,000	120,000
Wellington Meat Export Co., Ltd., Wellington ..	" ..	120	8,000	240,000
" " " ..	Kakariki† ..	100	2,000	90,000
Marlborough and Nelson.				
New Zealand Refrigerating Co., Ltd., Christchurch ..	Picton ..	30	2,400	30,000
Nelson Freezing Co., Ltd., Nelson	Stoke ..	30	500	50,000
Canterbury.				
Canterbury Frozen Meat and Dairy Produce Export Co., Ltd., Christchurch	Belfast ..	120	5,000	170,000
Ditto	Fairfield ..	..	4,500	100,000
"	Pareora ..	25	5,000	233,000
New Zealand Refrigerating Co., Ltd., Christchurch ..	Islington ..	50	9,000	258,440
" " " ..	Smithfield ..	50	5,800	300,000
North Canterbury Sheep-farmers' Co-operative Freezing Co., Ltd., Christchurch	Kaiapoi ..	..	5,000	222,000
Thomas Borthwick and Sons (Aus.), Ltd., Masterton ..	Belfast ..	..	6,500	70,000
Otago.				
Waitaki Farmers' Freezing Co., Ltd., Oamaru ..	Pukeuri ..	..	4,500	130,000
New Zealand Refrigerating Co., Ltd., Christchurch ..	Burnside ..	36	3,500	161,838
South Otago Freezing Co., Ltd., Balclutha	Finegand ..	50	3,500	200,000
Southland.				
Ocean Beach Freezing Co., Ltd., Invercargill ..	Ocean Beach ..	80	9,000	120,000
Southland Frozen Meat and Produce Export Co., Ltd., Invercargill	Mataura ..	50	4,000	124,000
Ditto	Makarewa ..	120	4,500	122,500
Totals	..	3,906	179,100	5,589,778

* Reopening, season 1934–35; disorganized by earthquake and fire in February, 1931. † Not operating.

—*Live-stock Division.*

When inspecting a top-dressing trial at Otaki, farmers agreed in considering super better than slag, and both much better than African and Nauru phosphates. As it was fourteen months since any manures had been applied, this was an interesting sidelight on the lasting effect of superphosphate.

WEATHER RECORDS: JUNE, 1934.

Dominion Meteorological Office.

NOTES FOR JUNE.

JUNE was, on the whole, a rather cold month, with less sunshine than usual. Until the last few days there was comparatively little wind, so that the low temperatures did not produce harmful effects. As regards total rainfall, conditions varied considerably in different districts, but generally it was rather humid.

Rainfall.—Owing chiefly to the heavy rains from the 18th to the 20th, practically the whole of the Auckland Province except the Poverty Bay and East Cape areas had considerably above the average rainfall for June. The same was the case in Nelson, Marlborough, and Southern Wellington. Over the east coast districts of the North Island, in Southern Taranaki, and Northern Wellington the totals fell short of the average. In the parts of the South Island not mentioned, the distribution was irregular, with totals below the average predominating. Generally, the number of rain days was high, so that even where the total rain was low the month was effectively a wet one. The storm of the 18th to 20th mentioned above was responsible for many very heavy rains from Nelson and Marlborough northwards.

Temperatures were for the most part slightly below normal, but the departures were important only in eastern districts and parts of the interior. At many places in western districts the normal was just exceeded. Owing to the still weather, many hard frosts were recorded. In the cold and boisterous weather at the end of the month there were heavy snowfalls on all the ranges, and even on much of the plain country of the South Island and the central plateau of the North. There were snowfalls on the Canterbury Plains also on the 9th.

Sunshine was everywhere considerably below normal. The best totals were recorded at Tauranga 149·6 hours and New Plymouth 136·7 hours.

Pressure and Weather Systems.—During the greater part of the month such storms as occurred were rather complicated in structure but not very vigorous. They consisted of irregular troughs of low pressure running in a north to south direction, there being a tendency for the lowest pressure to occur over the northern extremity of the Dominion. The first of these depressions passed on the 2nd, and was responsible for widespread rains with many heavy falls.

Later north-easterly gales arose in the far North and prevailed in some parts of the North Island until the 20th. Very heavy rains fell in the North, and by the 20th the area of precipitation had covered practically the whole of the Dominion.

On the 27th a much deeper trough of low pressure than had been experienced for a considerable time began to approach the Dominion from the Tasman Sea, and on the 28th a depression crossed the country and a southerly change advanced over the South Island. At this time pressure had become very high at Hobart, so that the invasion of cold air from the South was a very vigorous one. Snow commenced in the South that day, and hailstorms also were numerous. These conditions of southerly gales and intermittent heavy rains, with widespread snow and hailstorms, continued into July. Thunderstorms also occurred in many places. On the 25th a small tornado occurred near Opotiki.

RAINFALLS FOR JUNE, 1934, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.	Total for Year to Date.	Average for Year to Date.
	North Island.					
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	9·54	18	3·43	6·59	25·49	28·16
Russell	13·25	18	5·10	6·49	32·79	27·33
Whangarei	10·51	21	2·61	6·54	28·58	31·60
Auckland	6·48	19	2·15	4·95	26·81	21·99
Hamilton	6·39	15	2·36	5·11	21·88	23·90
Rotorua	8·94	14	4·96	5·25	26·85	26·87
Kawhia	5·74	15	1·77	5·72	27·95	25·54
New Plymouth	7·00	15	2·15	5·98	26·37	28·46
Riversdale, Inglewood	8·92	15	2·73	10·27	38·45	48·65
Whangamomona	5·10	8	1·53	7·89	33·91	35·70
Hawera	3·85	14	0·77	4·41	21·08	21·39
Tairua	8·97	14	2·25	6·97	28·41	33·56
Tauranga	7·45	16	3·75	5·40	28·83	26·86
Maraehako Station, Opotiki	7·81	15	2·57	5·66	23·80	27·79
Gisborne	2·03	13	0·91	4·90	13·19	24·91
Taupo	5·40	14	2·63	4·56	22·61	21·36
Napier	2·87	14	1·26	3·45	16·31	18·71
Hastings	2·30	13	0·96	3·07	13·90	16·63
Whakarara Station	5·46	9	3·60	..	27·50	..
Taihape	2·67	14	0·58	3·46	24·71	17·71
Masterton	2·89	19	1·23	3·63	16·96	18·83
Patea	3·13	14	0·61	4·24	20·90	21·40
Wanganui	2·04	13	0·44	3·37	18·70	17·70
Foxton	3·24	11	0·64	3·39	16·06	15·27
Wellington	4·81	20	1·24	4·19	20·82	20·29
	South Island.					
Westport	7·88	15	2·14	8·85	48·26	46·50
Greymouth	13·50	14	3·90	8·80	50·54	49·56
Hokitika	8·10	15	2·29	9·32	47·12	55·16
Ross	6·31	10	2·00	8·73	61·41	62·77
Arthur's Pass	11·27	9	4·47	10·53	77·30	75·94
Okuru, South Westland	..	..	..	10·72	..	72·04
Collingwood	14·35	18	4·22	10·30	39·81	45·68
Nelson	5·52	15	1·16	3·53	16·64	18·30
Spring Creek, Blenheim	5·35	16	1·75	2·94	13·74	14·47
Seddon	3·06	12	0·97	2·09	13·21	12·32
Hanmer Springs	2·58	15	0·86	3·49	31·11	21·61
Highfield, Waiau	1·73	9	0·60	2·47	21·22	16·74
Gore Bay	2·06	14	0·40	2·69	22·95	15·87
Christchurch	1·34	14	0·30	2·66	16·56	12·93
Timaru	2·28	9	0·70	1·72	16·91	11·08
Lambrook Station, Fairlie	2·11	11	0·38	1·86	17·50	11·98
Benmore Station, Clearburn	1·89	11	0·40	1·81	13·75	12·80
Oamaru	1·58	12	0·54	1·98	12·87	10·98
Queenstown	1·22	9	0·37	2·29	16·09	15·28
Clyde	0·83	7	0·28	0·92	11·40	7·76
Dunedin	1·94	14	0·34	3·16	21·62	18·13
Wendon	1·23	9	0·30	2·59	15·91	15·48
Balclutha	2·46	13	0·46	1·99	17·82	12·71
Invercargill	2·46	14	0·40	3·72	21·95	23·17
Puysegur Point	4·67	22	0·60	6·59	33·65	42·26
Half-moon Bay	2·43	16	0·52	4·91	23·49	29·13

RAGWORT.

ST. JOHN'S WORT.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

ST. JOHN'S WORT AND RAGWORT.

A. C. C., Moa Flat, Heriot :—

What is the difference between St. John's wort and ragwort, and how do they affect sheep? Does ragwort discolour the carcasses of sheep killed for mutton?

The Fields Division :—

St. John's wort (*Hypericum perforatum*) is a perennial, and grows to a maximum height of about 2 ft., but seldom more than 1 ft. 6 in. The stem is stiff and erect. The leaves are opposite and stalkless, so that the stem appears to "perforate" them. The leaves are about ½ in. long, green in colour, with a slight bluish-green tinge, and covered with tiny transparent dots, indicating the presence of oil glands. The flowers, about 1 in. in diameter, are bright yellow, five-petalled, star-like, and are borne in large terminal clusters. A striking part of the flower is the great number of long yellow stamens. St. John's wort seeds abundantly, and the seeds are contained in capsules. It has a twitchy creeping rootstock, which is fragile, as well as deep-penetrating roots, and is stimulated by ordinary methods of cultivation. It flourishes on free friable soils, and is a particularly common plant in the Queenstown district. Ragwort (*Senecio Jacobaea*) is better known on account of its wide distribution throughout both Islands. It is a perennial, springing from a thick rootstock, with abundant shallow roots, but there is no tendency in the rootstock to creep. The stems are stiff, upright, and much branched below, and reach a height of from 3 ft. to 5 ft. The leaves are irregular and pinnatifid. In colour the leaves are dark green on the upper surface, rather paler on the under surface. Some spring from the roots and have quite long stalks, others spring from the stem, these latter having no stalks, but clasp the stem closely. In the flowering season the stems branch very much above, the flower-heads being arranged in large clusters, but are all cut off at the same level and form a flat-topped bunch. The flower-heads are about 1 in. in diameter and bright yellow in colour. The cup underneath the flower-head is made up of scale-like leaves with black tips. Ragwort is readily distinguished from St. John's wort in that it is a taller, more robust plant, with irregular pinnatifid leaves, and the rootstock does not possess a creeping habit. Although St. John's wort is regarded as being dangerous to stock, it is not readily eaten, therefore being unpalatable it is only under "starving" conditions and where large quantities are consumed that stock mortality is likely to occur. Ragwort is particularly poisonous to cattle and horses. Sheep, however, resist the poisoning action to a much greater extent, and it is a common practice to control ragwort-infested properties by stocking with sheep. However, continued grazing by sheep of ragwort areas proves dangerous and mortality is likely to occur. A noticeable symptom is the yellow colour, affected animals being referred to as "yellow sheep," and it is stated that discoloration of the carcass occurs also.

Illustrations of the plants appear on the opposite page.—EDITOR.

SOWING CUPRESSUS LAWSONIANA AND MACROCARPA.

JOHN T., Mataura :—

When is the time to sow seeds of *C. macrocarpa* and *C. Lawsoniana* in Southland?

The Horticulture Division :—

In southern districts it is generally best to sow *Cupressus Lawsoniana* and *C. macrocarpa* in wide drills on prepared beds about 1st October, when the land is dry. Firm the seeds in the drills and cover lightly with screened soil containing a sufficient proportion of sand to prevent crusting.

SAND IN STOMACH OF SHEEP.

A. S. McI., Ruakituri, Wairoa, H.B. :—

I am sending you a sample of sand taken from the third stomach of a sheep. There was a considerable amount of this mixed with a watery fluid. (The sheep was in very poor condition with its wool very rough looking.) The first two inches of the intestine was enlarged to about twice the usual size, and the internal passage seemed to be almost entirely blocked with the sand. Do you know any way of curing sheep so affected ?

The Live-stock Division :—

The finding of sand or other foreign matter in one of the stomachs of ruminants is not uncommon. When, however, this foreign matter is so plentiful as to be found in the small intestines and other parts of the alimentary canal, the possibility of a mineral deficiency cannot be overlooked. When a deficiency exists in a pasture the animals are inclined to eat earth and sand in an attempt to make good the deficiency. In your high country, especially with a heavy rainfall, a mineral deficiency in all probability exists. The provision of a mineral lick to be placed in boxes on the camping-sites is recommended. A suitable lick may be prepared by mixing forty parts of agricultural salt with forty parts of sterilized bone-meal or bone-flour and twenty parts of limonite. Limonite is a compound of iron found in the North Auckland district. The lick should be placed in covered boxes protected from the prevailing wind.

SOYA BEANS IN CANTERBURY.

L. W. S., Clandeboye :—

Would the Soya bean grow successfully in South Canterbury ? If so, what month is most suitable for sowing, and what seeding is required ? Could you also tell me where the seed can be obtained, and give information as regards tillage of ground and manuring ?

The Fields Division :—

Little is known about the behaviour of Soya beans under Canterbury conditions. A number of trials were carried out at Christchurch in 1912 and 1913, but these were not very successful, although some of the varieties grew moderately well. The Department carried out a number of variety trials with Soya beans some years ago in the North Island, and quite a number of the varieties did well, but it was considered that any use they could be put to seemed more easily filled by other crops such as wheat, peas, &c. Soya bean seed is not readily procurable in Canterbury, but the firm of Arthur Yates and Co., seed-merchants, of Auckland, stocks two varieties, Manchu (which is stated to be a dwarf early-maturing variety) and Beloxi (a tall late-maturing variety). Soya beans will not withstand frost, and this suggests for Canterbury the use of the earlier-maturing variety. Seed sown in November should normally be ready for harvesting in April. The seed should be sown in rows sufficiently far apart to permit of some intercultivation. The amount of seed per acre will depend on the germination, and the row spacings. For normal seedings of good germinating seed, the seeds in the rows should be about 1 in. apart. A suitable fertilizer to apply with crops of this nature is carbonate of lime and superphosphate in equal parts sown at the rate of about 3 cwt. per acre. Basic super will also give good results, but heavy applications of super alone are liable to seriously retard germination of seed.

PAMPAS GRASS IN BRACKEN FERN.

W. B., Niagara :—

If I plant pampas grass amongst bracken fern would the pampas grass smother the fern out once it got established ?

The Chief Chemist :—

The young plants of pampas would have to be protected against competing bracken until they were tall enough to dominate the fern.